L11 ANSWER 23 OF 41 CA COPYRIGHT 2008 ACS on STN
AN 120:251887 CA
OREF 120:44471a,44474a
ED Entered STN: 14 May 1994
TI Extrusion of cement-based building materials
IN Tsugi, Yasushi
PA Kubota Kk, Japan
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM C04B028-02
ICS B28B003-20
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CC 58-4 (Cement, Concrete, and Related Building Materials)
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 06001648	A	19940111	JP 1992-189940	19920623
	JP 2736206	B2	19980402		
PRAI	JP 1992-189940		19920623		

CLASS

PATENT NO.	CLASS	PATENT FAMILY CLASSIFICATION CODES
JP 06001648	ICM	C04B028-02
	ICS	B28B003-20
	ICI	C04B028-02, C04B014-06, C04B016-02, C04B024-38, C04B024-22, C04B022-06, C04B016-08, C04B014-16
	IPCI	C04B0028-02 [ICM,5]; B28B0003-20 [ICS,5]; C04B0028-02 [ICI,5]; C04B0028-00 [ICI,5,C*]; C04B0014-06 [ICI,5]; C04B0016-02 [ICI,5]; C04B0024-38 [ICI,5]; C04B0024-22 [ICI,5]; C04B0024-00 [ICI,5,C*]; C04B0022-06 [ICI,5]; C04B0022-00 [ICI,5,C*]; C04B0016-08 [ICI,5]; C04B0016-00 [ICI,5,C*]; C04B0014-16 [ICI,5]; C04B0014-02 [ICI,5,C*]
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	ECLA	C04B028/02

AB In the extrusion of compns. comprising cement, SiO2 powder (0.7-1.3 weight parts/weight part cement), reinforcing fibers, lightwt. aggregate, and an extrusion aid, 0.1-3 weight% (based on the the above mixture) salt of naphthalenesulfonic acid-H2CO condensate and 3-15 weight% Mg(OH)2 are added to the mixture and then water is mixed to be extruded. A mixture prepared from cement 40, sand 53, cellulose pulp 7, foamed polystyrene beads 0.85, Me cellulose 0.6, and water 50 weight parts, with addition of Mighty 150 3.0, and Mg(OH)2 5-10 weight parts, was extruded and cured first at 30° for 15 h and then autoclaved at 6.7 kg/cm2 for 8 h to give smooth boards having bending strength 101 kg/cm2.
ST plasticizer magnesium hydroxide cement

Patent Abstracts of Japan

PUBLICATION NUMBER : 06144911
PUBLICATION DATE : 24-05-94

APPLICATION DATE : 04-11-92
APPLICATION NUMBER : 04321195

APPLICANT : KUBOTA CORP;

INVENTOR : SANUKI IKUO;

INT.CL. : C04B 28/02 B28B 3/20 C04B 16/02 C04B 16/06 //(C04B 28/02 , C04B 16:06 , C04B 16:02 , C04B 14:04 , C04B 18:14 , C04B 14:16 , C04B 24:22)

TITLE : EXTRUSION MOLDING METHOD FOR FIBER REINFORCED INORGANIC PRODUCT

ABSTRACT : PURPOSE: To improve bursting resistance by kneading a cement, a silica fume/ silica sand mixture, a synthetic fiber, a treated pulp fiber, a microbaloon and a water reducing agent and after molding, steam curing and autoclave curing.

CONSTITUTION: A silica constituent composed of a mixture having (15-25)/(85-75)wt.% silica fume having ≥8000cm^2/g particle size to silica sand are mixed with the cement by a prescribed weight ratio. Into the mixed material, 0.05wt.% more reinforcing fiber than asbestos such as PR fiber, 5-7wt.% pulp fiber on which a silica particulate is previously fixed, 6-10 volume % aggregate such as the micorbaloon made of polyvinylidene chloride and 0.5-1.5wt.% cement based water reducing agent such as naphthalenesulfonic acid-formaldehyde condensation product to (cement + silica) are added and kneaded. Next, the high strength and bursting resistant fiber reinforced inorganic product is obtained by extruding the kneaded material and after steam curing the molded material, autoclave curing in ≥4kg/cm^2 condition and air drying.

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審査請求　未請求　請求項の数１(全　５　頁)　最終頁に続く

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(54)【発明の名称】　繊維補強無機質製品の押出成形方法

(57)【要約】　(修正有)

【目的】　無石綿配合でありながら、石綿使用と同等の強度が得られ、しかも耐爆裂性にも優れ、製造コストも安価となし得る繊維補強無機質製品の押出成形方法を提供する。

【構成】　シリカ分としてシリカヒュームと粒度8,000cm²/g以上の珪砂の混合物を、また石綿以外の補強繊維として上記押出成形用配合に対し0.05％以上の、合成繊維と、予め表面にシリカ微粉末を定着させたパルプ繊維を同５～７％と、骨材として上記配合物に対し 6～10容積％のマイクロバルーンとを使用すると共に、セメントとシリカ分に対し0.5 ～1.5 重量％のセメント系減水剤を添加して混練し、該混練物を押出成形し蒸気養生後、４kg/cm²以上の条件でオートクレーブ養生する。

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【特許請求の範囲】

【請求項1】セメント、シリカ分、石綿以外の補強繊維、軽量骨材及び押出助剤を含む繊維補強無機質製品の押出成形用配合において、シリカ分としてシリカヒュームと粒度8,000cm²/g以上の珪砂であって、シリカヒューム：珪砂＝15～25:85 ～75　とされた混合物を、石綿以外の補強繊維として、上記押出成形用配合に対し0.05%以上の合成繊維と、同 5～7 %の予め表面にシリカ微粉末を定着させたパルプ繊維とを、骨材として上記配合物に対し 6～10容積%のマイクロバルーンとを使用すると共に、セメントとシリカ分に対し0.5 ～1.5 重量%のセメント系減水剤を添加して混練し、該混練物を押出成形し蒸気養生後、4kg/cm²以上の条件でオートクレーブ養生することを特徴とする繊維補強無機質製品の押出成形方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は繊維補強無機質製品の押出成形方法に関し、詳しくは、無石綿配合の繊維補強無機質製品の押出成形方法の改良に関する。

【0002】

【従来の技術】従来繊維補強セメント製品などの無機質製品の成形方法として、押出成形方法が周知である。これら無機質製品の補強繊維としては石綿が伝統的に使用されてきたが、石綿は公害の原因となること、及び資源枯渇の両面より使用の全廃が要請され、石綿代替繊維としてパルプ繊維、合成繊維など各種繊維が提案されかつ試みられている。

【0003】

【従来技術の問題点】しかし、石綿繊維の補強効果は今まで考えられてきた繊維に比し格段に優れており、石綿以外の補強繊維で石綿使用と同等の強度を発揮できるものは未だみいだされていない。従って、石綿使用と同等の強度を得るには、押出成形にあってはセメントマトリックスの結合強度を高める以外なく、このため押出圧力を40kg/cm²以上の高圧押出成形が必要とされ、製造装置などに大馬力のものを必要とし、製造コストがかかるといった問題があった。また、これら押出成形品の寸法安定性を増すため製品はオートクレーブ養生とすることが多いが、前記高い押出圧力とオートクレーブ養生との相乗により製品組織が緻密になりすぎ、強度は高いが火災時に爆裂し易い製品となる欠点があった。

【0004】

【発明が解決しようとする課題】この発明は上記問題点に鑑み、無石綿配合でありながら、石綿使用と同等の強度が得られ、しかも耐爆裂性にも優れ、製造コストも安価となし得る繊維補強無機質製品の押出成形方法を提供することを目的としてなされたものである。

【0005】

【課題を解決するための手段】即ち、この発明の繊維補強無機質製品の押出成形方法は、セメント、シリカ分、石綿以外の補強繊維、軽量骨材及び押出助剤を含む繊維補強無機質製品の押出成形用配合において、シリカ分としてシリカヒュームと粒度8,000cm²/g以上の珪砂であって、シリカヒューム：珪砂＝15～25:85 ～75　とされた混合物を、石綿以外の補強繊維として、上記押出成形用配合に対し0.05%以上の合成繊維と、同5～7 %の予め表面にシリカ微粉末を定着させたパルプ繊維とを、骨材として上記配合物に対し 6～10容積%のマイクロバルーンとを使用すると共に、セメントとシリカ分に対し0.5 ～1.5 重量%のセメント系減水剤を添加して混練し、該混練物を押出成形し蒸気養生後、4kg/cm²以上の条件でオートクレーブ養生することを特徴とするものである。

【0006】

【作用】この発明において、押出成形用配合物として使用されるセメント、シリカ分、石綿以外の補強繊維、軽量骨材その他押出助剤等の配合量そのものは従来と同じであり特に記する点はないが、これら使用材料の内、シリカ分、補強繊維の内容が異なる。

【0007】即ち、この発明の方法においてシリカ分は、シリカヒュームと粒度8,000cm²/g以上の珪砂であって、シリカヒューム：珪砂＝15～25:85 ～75　とされた混合物を使用する。粒度8,000cm²/g以上の珪砂は従来と同じであるが、これにシリカヒューム：珪砂＝15～25:85 ～75　となるようにシリカヒュームを添加混合する。

【0008】かかる割合にシリカヒュームを添加するのは、セメントマトリックスのC-H-Sオートクレーブ水和反応の適度化を図り、適度な強度を発現させるためであってシリカヒューム：珪砂＝25:75 の割合よりシリカヒュームを増加させると、セメントマトリックスの組織が緻密となりすぎ、強度は向上するものの耐爆裂性が得られなくなる。またシリカヒューム：珪砂＝15:85 の割合より珪砂を増加させると、水和反応が充分でなくセメントマトリックスの結合強度が充分でなくなり、充分な強度の製品とし難くなる。

【0009】次に、石綿以外の補強繊維として上記押出成形用配合に対し0.05%以上の、オートクレーブ養生条件が4kg/cm²以上の条件でも溶融分解しない合成繊維を使用するのは、未硬化製品に対し保形性を付与し、パルプでは得られない保形性を補うためである。また、この合成繊維の耐熱条件としてオートクレーブ養生条件が4kg/cm²以上の条件でも溶融分解しないものを使用するのは、養生硬化後も製品強度に寄与させるためであり、パルプ繊維では得られない長繊維による補強効果と耐爆裂性を発揮させるためである。このような合成繊維として、ポリプロピレン繊維、ポリノジックレーヨン繊維などが公的に使用される。その添加量を押出成形用配合に対し0.05%以上とするのは、これより少ないと保形性等の効果が得られなくなるからである。

【0010】パルプ繊維として、予め表面にシリカ微粉

末を定着させたものを使用するのはパルプ繊維とセメントマトリックスとの化学的結合性を良くするためであって、パルプ繊維とシリカ微粉末とを定着剤を加えた水添加の上混合し、その後乾燥したものなどが使用される。このパルプ繊維の添加量は従来配合と同じであり、押出成形用配合に対し 5%より少ないと補強効果が得られず、また 7%より多いと、製品の耐火性が損なわれるからである。

【００１１】骨材として押出成形用配合に対しマイクロバルーンを使用するのは製品の軽量化とマトリックス内に空隙を作り耐爆裂性を付与するためであって、ポリ塩化ビニリデンよりなるマイクロバルーンが好適に使用される。このマイクロバルーンの添加量を押出成形用配合に対し 6～10容積%とするのは、 6重量%より少ないと充分な軽量化が行われず、10容積%より多くすると相対的にセメント及びシリカ分の添加量が減少し充分なマトリックスの結合強度が得られなくなるからである。

【００１２】セメント系減水剤を使用するのは、押出助剤と相まってセメントスラリーの流動性を良くし、押出圧力の軽減化を図ると共に、セメント、珪砂等の粉体の分散性を高め、二次凝集した粒子の分散を良くしてマトリックス中の粗大空隙をなくして強度を高める。このセメント系減水剤としてはナフタリンスルフォン酸ホルマリン縮合物が好適に使用される。その添加量をセメントとシリカ分に対し 0.5～1.5 重量%とするのは0.5 重量%より少ないと添加の効果が無く、また 1.5重量%より多くしてもそれ以上の効果が望めず無駄となるからである。

【００１３】以上のシリカヒュームと粒度8,000cm²/g以上の珪砂、合成繊維、予め表面にシリカ微粉末を定着させたパルプ繊維、マイクロバルーンの使用及びセメント系減水剤の使用により、40kg/cm²以下の押出圧力で成形しても充分な強度の製品とでき、またマトリックスの適

度な結合強度により耐爆裂性が実現される。

【００１４】

【実施例】次に、この発明の実施例を説明する。セメント、シリカ分としてシリカヒュームと珪砂、石綿以外の補強繊維としてパルプ繊維とポリノジックレーヨン、マイクロバルーンとしてポリ塩化ビニリデン樹脂の中空粒子（松本油脂製薬株式会社：商品名「マイクロスフェアー」）、セメント系減水剤としてナフタリンスルフォン酸ホルマリン縮合物（株式会社花王：商品名「マイティー150 」）を用意した。

【００１５】まず、解繊したパルプ40重量%に粒度10,000cm²/g のシリカ微粉末60重量%を添加し、外割で30重量%の定着剤濃度 5%の水を添加してミキサで均一混合し、乾燥させ篩にかけて表面にシリカ微粉末を定着させたパルプ繊維を得た。また、シリカヒュームと粒度8,000cm²/gの珪砂を、シリカヒューム：珪砂＝15:85(シリカA)、同 25:75（シリカB）、シリカヒュームと粒度9,000cm²/gの珪砂をシリカヒューム：珪砂＝15:85(シリカC)、同 25:75（シリカD）としてシリカ分を調整した。

【００１６】以上の材料を表１に示す配合として添加し、押出圧力が18～25kg/cm²の範囲に入るように水を加えてセメントスラリーを調整し、このスラリーを押出成形して厚さ12mm、巾200mm 、長さ1,000mm の板状体を成形した。このとき、吐出直後の成形品の150mm スパンの垂れ量を測定した。また押出成形品は、30～60℃×12時間の蒸気養生後、６kg/cm²×８時間の条件でオートクレーブ養生し、その後７日間風乾し、試験板を得た。得た試験板について曲げ強度及び爆裂発生秒数の試験を行ったところ表２に示す結果となった。

【００１７】

【表１】

	実施例				比較例		
	1	2	3	4	1	2	3
セメント (重量%)	50	50	50	50	50	50	45
シリカ(A～D) (〃)	A 40	B 40	C 40	D 40	*2 40	*3 40	40
処理パルプ (〃)	5	5	6	7	*4 6	*4 6	—
砂 (〃)	5	5	4	3	4	4	—
石綿 (〃)	—	—	—	—	—	—	15
合成繊維 (外割%)	0.1	0.5	0.5	0.1	—	0.1	—
マイクロバルーン*1 (外割容積%)	10	8	6	6	—	—	—
押出助剤(MC) (外割%)	1	1	1	1	1	1	1
マイティー 150 (〃)	1	0.8	1.5	1	2	—	—

表1において
＊1　マツモトマイクロスフェアー　　＊3　フライアッシュのみ使用
＊2　粒度3,500cm²/gの珪砂のみ使用　　＊4　シリカ＊
＊固定処理なし

【0018】
【表2】

	実施例				比較例		
	1	2	3	4	1	2	3
曲げ強度 (kg/cm²)	251	236	217	198	173	147	225
爆裂発生秒数 *1	10分 ok	10分 ok	10分 ok	10分 ok	15 秒	10分 ok	12 秒
150mm スパン 垂れ量*2	2.0	1.8	1.2	0.5	3.5	3.1	2.1

表2において
＊1　スレート協会方式に準拠した試験方法で 925℃の火炎中に試験板を10分間さらし、その間に爆裂を起こすまでの秒数を測定したものである。
＊2　押出直後の未硬化板材をスパン150mm で支え、中央部の垂れ量を測定したものである。

【0019】表1及び表2より明らかなように、この発明の実施例のものは、押出圧力が低いにも係わらず製品強度が得られ、しかも爆裂しにくい製品を成形できることが判明した。

【0020】

【発明の効果】以上説明したように、補強繊維の選択と処理、シリカ分となる珪砂とシリカヒューム、マイクロバルーン、減水剤の組み合わせによって、従来の押出成形法では実現出来なかった高強度かつ耐爆裂性を有した繊維補強無機質製品を押出成形することが可能となったのである。

フロントページの続き

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	16:02		2102－4G		
	14:04	Z	2102－4G		
	18:14	Z	2102－4G		
	14:16		2102－4G		
	24:22)	A	2102－4G		

L11 ANSWER 20 OF 41 CA COPYRIGHT 2008 ACS on STN
AN 122:272330 CA
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ED Entered STN: 27 May 1995
TI High-flowability cement compositions
IN Hayakawa, Kazuhisa; Kobayashi, Kazuto
PA Shinetsu Chemical Industry Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 8 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM C04B028-02
ICS C04B024-04; C04B024-22; C04B024-32; C04B024-38
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CLASS

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	ICS	C04B024-04; C04B024-22; C04B024-32; C04B024-38
	ICI	C04B028-02, C04B014-06, C04B016-02, C04B016-06, C04B024-38, C04B024-22, C04B024-32; C04B103-40
	IPCI	C04B0028-02 [ICM,6]; C04B0024-04 [ICS,6]; C04B0024-22 [ICS,6]; C04B0024-32 [ICS,6]; C04B0024-38 [ICS,6]; C04B0028-02 [ICI,6]; C04B0028-00 [ICI,6,C*]; C04B0014-06 [ICI,6]; C04B0014-02 [ICI,6,C*]; C04B0016-02 [ICI,6]; C04B0016-06 [ICI,6]; C04B0016-00 [ICI,6,C*]; C04B0024-38 [ICI,6]; C04B0024-22 [ICI,6]; C04B0024-32 [ICI,6]; C04B0024-00 [ICI,6,C*]; C04B0103-40 [ICI,6]
	IPCR	C04B0024-04 [I,A]; B28B0003-20 [I,C*]; B28B0003-20 [I,A]; C04B0024-00 [I,C*]; C04B0024-08 [I,A]; C04B0024-22 [I,A]; C04B0024-32 [I,A]; C04B0024-38 [I,A]; C04B0028-00 [I,C*]; C04B0028-02 [I,A]; C04B0103-40 [N,A]
	ECLA	C04B028/02

AB Into cement-based compns. containing a dispersant comprising aryl sulfonate (with or without alkyl substitution)-H2CO condensate, cellulose-based binder and water, a nonionic surfactant derived from higher fatty acids is added. Thus, a composition comprising cement 70, silica powder 30, pulp 4.5, polypropylene fiber 0.5, hydroxypropylmethylcellulose 1.0, β-naphthalenesulfonic acid-formalin condensate 0.3, polyoxyethylene monooleate 0.02, and water 22 parts was extruded and autoclaved at 170° for 8 h to give a concrete having bending strength 310 kg/cm2.
ST nonionic surfactant fatty acid cement

First Hit

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L1: Entry 1 of 2 File: JPAB Mar 12, 1996

PUB-NO: JP408067541A
DOCUMENT-IDENTIFIER: JP 08067541 A
TITLE: FIBER CEMENT BOARD

PUBN-DATE: March 12, 1996

INVENTOR-INFORMATION:
NAME COUNTRY
NOZAKI, AKITOSHI

ASSIGNEE-INFORMATION:
NAME COUNTRY
KUBOTA CORP

APPL-NO: JP06204090
APPL-DATE: August 30, 1994

INT-CL (IPC): C04 B 28/02; B32 B 13/02; C04 B 14/18; C04 B 14/24; C04 B 18/24; E04 C 2/04

ABSTRACT:

PURPOSE: To obtain a fiber cement board moldable efficiently while retaining its handleability even in the case of being highly thick, and hard to develop interlaminar debonding, by integrally putting porous granules interlaminarly into a laminate consisting of fibrous material-contg. cement slurry.

CONSTITUTION: This fiber cement board is obtained by plurally laminating layers each consisting of fibrous material P-contg. cement slurry S; in this case, porous granules 2 are integrally put interlaminarly into the laminate. It is preferable that the porous granules 2 be of at least one kind selected from cellular perlite, silas balloons, vermiculite and synthetic resins.

First Hit

End of Result Set

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L1: Entry 2 of 2 File: DWPI Mar 12, 1996

DERWENT-ACC-NO: 1996-196467
DERWENT-WEEK: 199620

TITLE: Fibre-contg. cement plate - includes film layers or cement slurry contg. fibres laminated to one another, with porous granular material interposed

PATENT-ASSIGNEE:

ASSIGNEE	CODE
KUBOTA CORP	KUBI

PRIORITY-DATA: 1994JP-0204090 (August 30, 1994)

Search Selected | Search ALL | Clear

PATENT-FAMILY:

	PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
☐	JP 08067541 A	March 12, 1996		005	C04B028/02

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
JP 08067541A	August 30, 1994	1994JP-0204090	

INT-CL (IPC): B32 B 13/02; C04 B 14/18; C04 B 14/24; C04 B 18/24; C04 B 28/02; E04 C 2/04

ABSTRACTED-PUB-NO: JP 08067541A
BASIC-ABSTRACT:

Cement plate includes film layers 1 made of cement slurry S contg. fibres P and laminated one upon another. Porous granular material (2) is integrally interposed between adjacent film layers.

ADVANTAGE - Even thick cement plate can be effectively produced with good appearance and high handling property.

CHOSEN-DRAWING: Dwg.1/3

TITLE-TERMS: FIBRE CONTAIN CEMENT PLATE FILM LAYER CEMENT SLURRY CONTAIN FIBRE LAMINATE ONE POROUS GRANULE MATERIAL INTERPOSED

DERWENT-CLASS: L02 P73 Q44

CPI-CODES: L02-D05;

SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1996-062008
Non-CPI Secondary Accession Numbers: N1996-164955

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Ｃ０４Ｂ　14/18				
14/24				
18/24		Ｚ		

審査請求　未請求　請求項の数２　ＯＬ　（全　５　頁）　最終頁に続く

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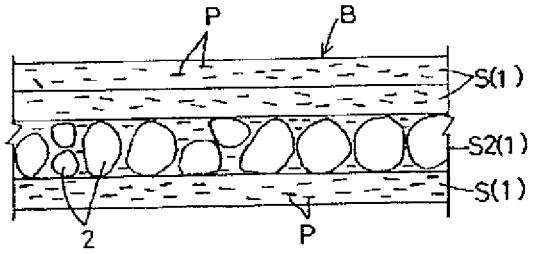
(54)【発明の名称】　繊維セメント板

(57)【要約】
【目的】　厚みの大きいものでもハンドリング性を維持したまま効率よく形成でき、且つ、層間剥離を生じ難くする。
【構成】　多孔質粒状物２を、繊維材Ｐを含むセメントスラリーＳからなる膜層１を複数積層させた膜層１間に一体的に介在させて形成してある。



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【特許請求の範囲】
【請求項１】　繊維材（Ｐ）を含むセメントスラリー（Ｓ）からなる膜層（１）を、複数積層させて形成してある繊維セメント板であって、
多孔質粒状物（２）を、前記複数の膜層（１）間に一体的に介在させてある繊維セメント板。
【請求項２】　前記多孔質粒状物（２）は、発泡パーライト・シラスバルーン・ひる石・合成樹脂から選択される一つ又は複数で構成してある請求項１に記載の繊維セメント板。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、繊維材を含むセメントスラリーからなる膜層を、複数積層させて形成してある繊維セメント板に関する。
【０００２】
【従来の技術】従来、この種の繊維セメント板としては、ハンドリング性の良好な製品、即ち、配合繊維材の面配向性の高い製品とするために、前記セメントスラリーによる薄い膜層を複数積層させて形成してあり、前記積層回数を調整することで所定厚さの繊維セメント板を形成するものであった。
【０００３】
【発明が解決しようとする課題】上述した従来の繊維セメント板によれば、例えば、厚い繊維セメント板とするためには、前記セメントスラリーの積層回数が増加し、その増加に伴って製作時間もかかり、製造効率の低下、及び、コストアップにつながる問題点がある。更には、積層回数を多くするほど、各層を一体化するためのプレス圧が作用し難くなり、充分な付着力が得られない場合には、層間剥離を発生し易くなるという問題点もある。
【０００４】また、この問題を解消するために、例えば、前記セメントスラリーの供給量を増加することによって膜層一層当りの厚み増加を図ったり、粒状物をセメントスラリーに混ぜてボリュームアップしたものが提案されるが、この場合には、積層回数は少なくなるものの、一層あたりの厚みが増える分、前記繊維材の面配向性が低下し、ハンドリング性能がわるくなるという新たな問題が発生する。更には、別の問題解消策として、粒状物を前記複数のセメントスラリー膜層間に介在させ、繊維セメント板全体としての板厚を増加させるものが提案されるが、この場合には、積層回数は少なくなり、且つ、繊維材の面配向性も維持できるものの、前記粒状物とセメントスラリー硬化部との付着力が低くなることが懸念され、層間剥離を生じ易くなるという問題が発生する。
【０００５】従って、本発明の目的は、上記問題点を解消し、厚みの大きいものでもハンドリング性を維持したまま効率よく形成でき、且つ、層間剥離を生じ難い繊維セメント板を提供するところにある。

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【０００６】
【課題を解決するための手段】この目的を達成するための本発明の繊維セメント板の特徴構成は、多孔質粒状物を、繊維材を含むセメントスラリーからなる膜層を複数積層させた前記膜層間に一体的に介在させて形成してあるところにある。
【０００７】尚、前記多孔質粒状物は、発泡パーライト・シラスバルーン・ひる石・合成樹脂から選択される一つ又は複数で構成してあってもよい。
【０００８】
【作用】本発明の繊維セメント板の特徴構成によれば、多孔質粒状物を、繊維材を含むセメントスラリーからなる膜層を複数積層させた前記膜層間に一体的に介在させて形成してあるから、当該繊維セメント板の表裏面は、前記セメントスラリー硬化部で構成され、従来品と何等変わらない表面美観性を維持することができながら、繊維材による面配向性の維持をも叶えることができ、更には、介在させる多孔質粒状物の粒径を調節することによって、セメントスラリーの積層回数を従来のように増加させなくても、厚い繊維セメント板に形成することが可能となり、生産効率を向上させることが可能となる。
【０００９】更には、前記セメントスラリーは、前記多孔質粒状物の多孔に接触して絡んだ状態で硬化することが可能となり、セメントスラリー硬化部と多孔質粒状物との間に高い付着力を付与することができる。従って、上述した単なる粒状物をセメントスラリーの膜層間に介在させてあるものに比べて、層間剥離の少ない繊維セメント板とすることができる。そして、前記セメントスラリー硬化部と多孔質粒状物との高付着力、及び、繊維材の平面配向性維持作用とによって、ハンドリング性能をも向上させることが可能となる。
【００１０】また、多孔質粒状物内に分布する多孔（又は、発泡部）によって、見掛け比重の低下が図られ、繊維セメント板の軽量化を叶えることが出来ると共に、前記多孔（又は、発泡部）内に形成される空間によって、繊維セメント板の断熱性能を向上させることが可能となる。
【００１１】尚、前記多孔質粒状物は、発泡パーライト・シラスバルーン・ひる石・合成樹脂から選択される一つ又は複数で構成してあれば、上述の独特の作用を叶えることができながら、比較的低コストで入手し易い材料であるから、材料の調達性や原価面での大量生産性の向上を叶え易くなる。
【００１２】
【発明の効果】従って、本発明の繊維セメント板によれば、厚みの大きいものでも効率よく形成でき、しかも、表面美観性・ハンドリング性を好適に維持できながら、軽くて断熱性能・層間剥離防止性に富んでいるから、経済性・取扱性・機能性を共に向上させることができるようになる。

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【0013】

【実施例】以下に本発明の実施例を図面に基づいて説明する。

【0014】本実施例の繊維セメント板Bは、セメント瓦のもととなるもので、図1に示すように、パルプ繊維（繊維材の一例）Pを含むセメントスラリーSからなる膜層1を複数積層させると共に、多孔質粒状物2を、前記複数の膜層1間に一体的に介在させて構成してある。

【0015】前記セメントスラリーSは、具体的には、ケイ酸カルシウムを主成分とするセメント：44．5%、パルプ繊維：6．0%、シリカ：44．5%、マイカ：5．0%等からなる主材と着色顔料と水とを混合して形成してある。

【0016】前記多孔質粒状物2は、例えば、発泡バーライト・シラスバルーン・ひる石・合成樹脂等の粒状物の、単一、又は、複数種で構成することができ、表面には、多数の孔開口が存在し、この孔開口に前記セメントスラリーSが浸入した状態で硬化することで、両者の付着力アップを図れるように構成してある。また、多孔質粒状物2の内部にも、多数の孔が存在する。

【0017】次に、前記繊維セメント板Bを形成するための形成装置を説明する。

【0018】図2は、形成装置を示すもので、図中、3は、前記膜層1や多孔質粒状物2を積層させるためのフェルトコンベヤである。そのフェルトコンベヤ3の上方には、前記膜層1形成用原料の前記セメントスラリーSを貯留自在で、且つ、貯留した前記セメントスラリーSを前記フェルトコンベヤ3上へ適宜供給自在な第一フローボックス4と、前記セメントスラリーSに多数の前記多孔質粒状物2を混入させた粒状物スラリーS2を貯留自在で、且つ、貯留した前記粒状物スラリーS2を前記フェルトコンベヤ3上へ適宜供給自在な第二フローボックス5とが配置してある。また、前記フェルトコンベヤ3の下流側部分には、前記フェルトコンベヤ3との間に、前記フェルトコンベヤ3上に形成された繊維セメント板Bに厚み方向の加圧力を作用させるための加圧ロール6が設けられている。

【0019】前記フェルトコンベヤ3は、透水性を有するフェルト製のコンベヤベルト3aを備え、上面に供給された各スラリーS，S2の水分を下方へ透過できるように構成してある。また、前記フェルトコンベヤ3内には、前記各スラリーS，S2から水分を吸引除去自在な複数のサクションボックス7が、前記コンベヤベルト3aの下面に沿って配置されており、それら複数のサクションボックス7を用いることにより、前記フェルトコンベヤ3上にて、前記各フローボックス4，5から供給された前記各スラリーS，S2から水分を適宜吸引除去して、前記繊維セメント板Bを形成できるように構成してある。

【0020】前記第一・第二フローボックス4，5は、

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形成装置の装置本体8に対して、前記フェルトコンベヤ3の搬送方向に沿って移動自在に取り付けてある。また、装置本体8には、前記両フローボックス4，5を、前記搬送方向の前後に沿って各別に往復駆動操作自在な駆動装置8aを設けてある。前記各フローボックス4，5の詳細を説明すると、前記セメントスラリーS（又は、粒状物スラリーS2）を貯留自在な貯留部9を設け、前記貯留部9に貯留された前記セメントスラリーS（又は、粒状物スラリーS2）を、下方のフェルトコンベヤ3上へ流下自在な排出部10を設けて構成してある。前記貯留部9には、図には示さないが、別途設けられたセメントスラリー製造装置（又は、粒状物スラリー製造装置）で調合されたセメントスラリーS（又は、粒状物スラリーS2）が適宜送られてくる。

【0021】本実施例の繊維セメント板Bの形成方法は、図3（イ）に示すように、コンベヤベルト3aを停止した状態で、前記第一フローボックス4を、前記駆動装置5aによってコンベヤベルト3aの搬送方向に沿って駆動させながら、フェルトコンベヤ3のほぼ全長にわたって前記セメントスラリーSを供給して膜層1を一層形成すると共に、コンベヤベルト3a上に供給された前記セメントスラリーSの水分を、前記サクションボックス7によってコンベヤベルト3aの下方へ吸引する。

【0022】次に、図3（ロ）に示すように、前記第二フローボックス5を、前記駆動装置5aによってコンベヤベルト3aの搬送方向に沿って駆動させながら、フェルトコンベヤ3のほぼ全長にわたって前記薄膜2上に前記粒状物スラリーS2を供給して積層させる。

【0023】そして、図3（ハ）に示すように、前記第一フローボックス4を、前記駆動装置5aによってコンベヤベルト3aの搬送方向に沿って前後駆動させながら、フェルトコンベヤ3のほぼ全長にわたって前記多孔質粒状物2の層上に前記セメントスラリーSを供給して膜層1を複数積層させる。

【0024】次に、図3（ニ）に示すように、フェルトコンベヤ3を搬送方向へ駆動し、前記加圧ロール6によって膜層1の積層体を加圧して繊維セメント板Bを形成する。

【0025】尚、このようにして形成された繊維セメント板Bは、後工程へ移送し、そこで、適宜選択された複数の後処理が施されることにより、製品としてのセメント瓦が完成する。前記複数の後処理としては、例えば、高圧プレス装置による高圧プレス（例えば、250kg／cm²の条件でのプレス）、そのプレス後の自然養生、パンチング、下塗り塗装、オートクレーブ養生（即ち、高圧・高温の蒸気に一定時間（例えば、10hr）曝して養生する処理）、上塗り塗装等であり、前記高圧プレスは、前記板状体の余剰水分の絞り出しを行い、前記繊維セメント板Bの強度を向上させるのに寄与する。また、前記オートクレーブ養生は、セメント等の原料を

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化学的に結合させるのに寄与する。

【００２６】本実施例の繊維セメント板によれば、表裏面は、前記セメントスラリーＳの硬化部で構成されるから、多孔質粒状物２による凸凹が表面に表れ難く、表面美観性を維持することができると共に、前記膜層１を多数積層させなくても、厚いものが効率よく形成でき、しかも、多孔質粒状物２と膜層１との付着、及び、膜層１でのパルプ繊維Ｐの面配向が共に良好であるから、層間剥離を生じ難く、高いハンドリング性能を確保することが可能となる。そして、軽いから取扱性がよく、更には、断熱性能が高いから、特に、屋根や壁等に用いる建材として好適である。

【００２７】次に、別実施例について説明する。

【００２８】前記セメントスラリーは、先の実施例に説明したセメントとパルプ繊維・シリカ・マイカ・着色顔料・水とを混合して形成するものに限定されるものではなく、例えば、パルプ繊維に替えてガラス繊維や炭素繊維や石綿、シリカ３に替えて他の骨材を配合するものであってもよく、更には、マイカや着色顔料を含まないもの、またそれらを組み合わせたものであってもよい。更には、混和材等を含むものであってもよい。それらを含

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めて、セメントスラリーと総称する。

【００２９】また、膜層の形成方法は、先の実施例に限定されるものではなく、例えば、長網や丸網を用いて実施される周知の抄造法であってもよい。更には、多孔質粒状物の供給方法は、先の実施例で説明したようにセメントスラリーに混入させた状態で実施する方法の他、例えば、粒のまま単独で散布供給する方法もとることができる。

【００３０】尚、特許請求の範囲の項に、図面との対照を便利にするために符号を記すが、該記入により本発明は添付図面の構成に限定されるものではない。

【図面の簡単な説明】

【図１】実施例の繊維セメント板を示す要部の断面図

【図２】実施例の繊維セメント板形成装置を示す概念図

【図３】実施例の繊維セメント板の形成方法を示す説明図

【符号の説明】

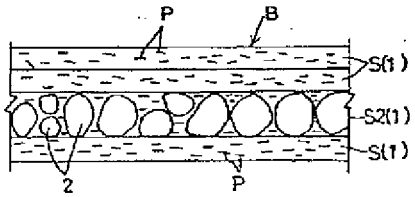
１　膜層

２　多孔質粒状物

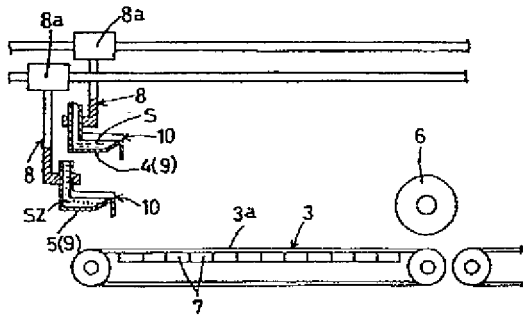
Ｐ　繊維材

Ｓ　セメントスラリー

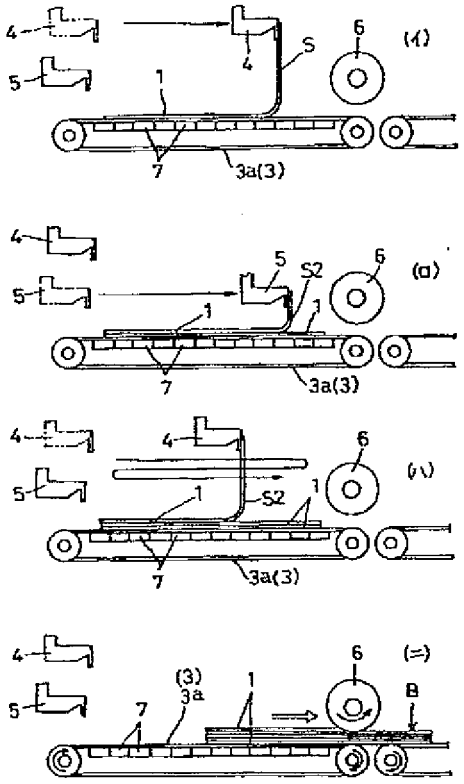
【図１】



【図２】



【図3】



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the fiber cement board which is made to carry out two or more laminatings of the membrane layer which consists of a cement slurry containing a fiber material, and has been formed.
[0002]
[Description of the Prior Art] In order to carry out to the good product of handling nature, i.e., the high product of the plane orientation nature of a combination fiber material, as this kind of a fiber cement board conventionally, it was what is made to carry out two or more laminatings of the thin membrane layer by said cement slurry, has formed, and forms the fiber cement board of predetermined thickness by adjusting said count of a laminating.
[0003]
[Problem(s) to be Solved by the Invention] According to the conventional fiber cement board mentioned above, in order to consider as a thick fiber cement board for example, the count of a laminating of said cement slurry increases, manufacture time amount is also taken with the increment, and there are decline in manufacture effectiveness and a trouble which leads to a cost rise. Furthermore, when press ** for unifying each class stops being able to act easily and sufficient adhesion force is not obtained so that the count of a laminating is made [many], there is also a trouble of becoming easy to generate interlaminar peeling.
[0004] Moreover, although increased thickness per one layer of membrane layers is planned by increasing the amount of supply of said cement slurry in order to solve this problem or what mixed the granular object with the cement slurry and carried out the volume rise is proposed In this case, the part of what decreasing whose neighboring thickness increases further, and the plane orientation nature of said fiber material fall, and the new problem that the handling engine performance worsens generates the count of a laminating. Furthermore, although the thing to which make a granular object intervene among said two or more cement slurry membrane layers, and the board thickness as the whole fiber cement board is made to increase as another problem dissolution measure is proposed In this case, although the count of a laminating decreases and the plane orientation nature of a fiber material can also be maintained, the problem that we are anxious about the adhesion force of said granular object and a cement slurry hard spot becoming low, and it becomes easy to produce interlaminar peeling occurs.
[0005] Therefore, the purpose of this invention is in the place which offers the fiber cement board which cancels the above-mentioned trouble, can form efficiently while what has large thickness had maintained handling nature, and cannot produce interlaminar peeling easily.
[0006]
[Means for Solving the Problem] A place which is made to intervene in one and has been formed between said membrane layers to which two or more laminatings of the membrane layer which consists a porosity granular object of a cement slurry containing a fiber material were carried out has the feature configuration of a fiber cement board of this invention for attaining this purpose.
[0007] In addition, said porosity granular object may consist of one or more which are chosen from foaming pearlite milt balun, a vermiculite, and synthetic resin.
[0008]
[Function] Since according to the feature configuration of the fiber cement board of this invention it is made to intervene in one and has formed between said membrane layers to which two or more laminatings of the membrane layer which consists a porosity granular object of a cement slurry containing a fiber material were carried out While the surface fine sight nature which the table rear face of the fiber cement board concerned consists of said cement slurry hard spots, and is not conventionally different from elegance at all is maintainable It can also fulfill maintenance of the plane orientation nature by the fiber material. Further Even if it does not make the count of a laminating of a cement slurry increase like before by adjusting the particle size of the porosity granular object made to intervene, it becomes possible to form in a thick fiber cement board, and it becomes possible to raise productive efficiency.
[0009] Furthermore, said cement slurry becomes possible [hardening in the condition of having been contacted and involved in the porosity of said porosity granular object], and can give high adhesion force between a cement slurry hard spot and a porosity granular object. Therefore, the mere granular object mentioned above can be used as a fiber cement board with little interlaminar peeling compared with the thing made to have intervened between the membrane layers of a cement slurry. And the high adhesion force of said cement slurry hard spot and a porosity granular object and a plane stacking tendency maintenance operation of a fiber material enable it to also raise the handling engine performance.

[0010] Moreover, while the fall of apparent specific gravity is achieved and being able to fulfill lightweight-ization of a fiber cement board with the porosity (or foaming section) distributed in a porosity granular object, the space formed in said porosity (or foaming section) enables it to raise the heat insulation property of a fiber cement board.
[0011] In addition, if said porosity granular object is constituted from one or more which are chosen from foaming pearlite milt balun, a vermiculite, and synthetic resin, since it is a material which is comparatively easy to come to hand by low cost, being able to fulfill an above-mentioned peculiar operation, it becomes easy to fulfill improvement in the supply nature of a material, or the high-volume production capability in a cost side.
[0012]
[Effect of the Invention] Therefore, according to the fiber cement board of this invention, what has large thickness can be formed efficiently, and moreover, since it is light and rich in heat insulation property and interlaminar-peeling tightness while surface fine sight nature and handling nature are suitably maintainable, both economical efficiency [and], handling nature, and functionality can be raised.
[0013]
[Example] The example of this invention is explained based on a drawing below.
[0014] Fiber cement board B of this example makes the porosity granular object 2 intervene in one among said two or more membrane layers 1, and is constituted while carrying out two or more laminatings of the membrane layer 1 which consists of a cement slurry S containing pulp fiber (an example of a fiber material) P, as it becomes the basis of a cement roof tile and is shown in drawing 1 .
[0015] Cement:44.5%, pulp fiber:6.0%, silica:44.5%, a mica to which said cement slurry S specifically uses a calcium silicate as a principal component: The principal member, the color pigment, and water which consist of 5.0 etc.% etc. are mixed, and it has formed.
[0016] It can constitute from a single of granular objects, such as for example, foaming pearlite milt balun, a vermiculite, synthetic resin, etc., or two or more sorts, and many hole openings exist in the surface, and said porosity granular object 2 consists of hardening, after said cement slurry S has infiltrated into this hole opening so that both adhesion force rise can be aimed at. Moreover, many holes exist also in the interior of the porosity granular object 2.
[0017] Next, the formation equipment for forming said fiber cement board B is explained.
[0018] Drawing 2 shows formation equipment and three are a felt conveyor for carrying out the laminating of said membrane layer 1 or the porosity granular object 2 among drawing. Said cement slurry S of said raw material for membrane layer 1 formation can be freely stored above the felt conveyor 3. And the granular object slurry S2 which made said a majority of porosity granular objects 2 mix said stored cement slurry S in the first flow box 4 which can be supplied freely suitably, and said cement slurry S to up to said felt conveyor 3 can be stored freely. And the second flow box 5 which can be supplied freely suitably arranges said stored granular object slurry S2 to up to said felt conveyor 3. Moreover, the pressure roll 6 for making the welding pressure of the thickness direction act on fiber cement board B formed on said felt conveyor 3 is formed between said felt conveyors 3 at the downstream portion of said felt conveyor 3.
[0019] Said felt conveyor 3 is equipped with conveyor-belt 3a made from the felt which has water permeability, and it constitutes it so that the moisture of each slurries S and S2 supplied to the upper surface can be penetrated below. In said felt conveyor 3, moreover, two or more suction boxes 7 in which suction removal of moisture is free from said each slurries S and S2 By being arranged along the inferior surface of tongue of said conveyor-belt 3a, and using the suction box 7 of these plurality Suction removal of the moisture is suitably carried out from said each slurries S and S2 supplied from said each flow boxes 4 and 5, and it constitutes from on said felt conveyor 3 so that said fiber cement board B can be formed.
[0020] The - second flow box 4 and 5 is attached free [migration] along the conveyance direction of said felt conveyor 3 to the main part 8 of equipment of formation equipment for a start [said]. Moreover, said both flow boxes 4 and 5 are established for driving gear 8a in which both-way drive actuation is free in the main part 8 of equipment along said conveyance direction order at each **. If the details of each of said flow boxes 4 and 5 are explained, the reservoir section 9 which can store said cement slurry S (or granular object slurry S2) freely is formed, and said cement slurry S (or granular object slurry S2) stored by said reservoir section 9 is prepared and constituted in the discharge section 10 which can flow down freely to up to the downward felt conveyor 3. Although not shown in drawing, the cement slurry S (or granular object slurry S2) prepared by the cement slurry manufacturing installation (or granular object slurry manufacturing installation) prepared separately is suitably sent to said reservoir section 9.
[0021] The formation method of fiber cement board B of this example is in the condition which stopped conveyor-belt 3a, as shown in drawing 3 (b). while making said first flow box 4 drive along the conveyance direction of conveyor-belt 3a by said driving gear 5a -- the felt conveyor 3, while supplying said cement slurry S covering an overall length mostly and forming a membrane layer 1 further The moisture of said cement slurry S supplied on conveyor-belt 3a is attracted under the conveyor-belt 3a with said suction box 7.
[0022] next -- while making said second flow box 5 drive along the conveyance direction of conveyor-belt 3a by said driving gear 5a as shown in drawing 3 (b) -- the felt conveyor 3 -- the laminating of said granular object slurry S2 is mostly supplied and carried out on said thin film 2 covering an overall length.
[0023] and -- while making said first flow box 4 drive along the conveyance direction of conveyor-belt 3a approximately by said driving gear 5a as shown in drawing 3 (Ha) -- the felt conveyor 3 -- said cement slurry S is mostly supplied on the layer of said porosity granular object 2 covering an overall length, and two or more laminatings of the membrane layer 1 are carried out.
[0024] Next, as shown in drawing 3 (d), the felt conveyor 3 is driven in the conveyance direction, with said pressure roll 6, the

layered product of a membrane layer 1 is pressurized and fiber cement board B is formed.
[0025] In addition, the cement roof tile as a product completes fiber cement board B formed by doing in this way by transporting to an after production process and performing two or more after treatment chosen suitably there. The high-pressure press according to high-pressure press equipment for example as said two or more after treatment (For example, the press in 250kg/cm2 conditions), the natural regimen after the press, They are punching, under coat paint, autoclave curing (namely, processing which fixed-time-amount(for example, 10-hr)-puts to a high-pressure and hot steam, and recuperates itself), finishing paint, etc. said high-pressure press Extraction for redundant water of said plate is performed, and it contributes to raising the reinforcement of said fiber cement board B. Moreover, said autoclave curing contributes raw materials, such as cement, to making it join together chemically.
[0026] According to the fiber cement board of this example, a table rear face Since it consists of hard spots of said cement slurry S, while the unevenness by the porosity granular object 2 cannot appear in the surface easily and can maintain surface fine sight nature Even if it does not carry out the laminating of a majority of said membrane layers 1, a thick thing can form efficiently, and moreover, since both the plane orientation of adhesion with the porosity granular object 2 and a membrane layer 1 and the pulp fiber P in a membrane layer 1 is good, it is hard to produce interlaminar peeling, and it becomes possible to secure the high handling engine performance. And since it is light, handling nature is good, and since heat insulation property is still higher, it is suitable as building materials especially used for a roof, a wall, etc.
[0027] Next, another example is explained.
[0028] Said cement slurry is not limited to what mixes and forms the cement, and the pulp fiber, the silica mica, the color pigment and water which were explained to the previous example, it may be changed to pulp fiber, for example, may be changed to a glass fiber, a carbon fiber, asbestos, and a silica 3, may not blend other aggregates, and may combine further the thing which contains neither a mica nor a color pigment, and them. Furthermore, a chemical admixture etc. may be included. It is named a cement slurry generically including them.
[0029] Moreover, the formation method of a membrane layer may be a method of milling the common knowledge which is not limited to a previous example and carried out using a long network or ****. Furthermore, the supply method of a porosity granular object can also take the method of carrying out spraying supply independently still in the state else { method / of enforcing in the condition of having made it mixing in a cement slurry as the previous example explained }, for example, a grain.
[0030] In addition, although a sign is described in the term of a claim in order to make contrast with a drawing convenient, this invention is not limited to the configuration of an accompanying drawing by this entry.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] A fiber cement board which it is [fiber cement board] the fiber cement board which is made to carry out two or more laminatings of the membrane layer (1) which consists of a cement slurry (S) containing a fiber material (P), and has been formed, and makes a porosity granular object (2) have intervened in one among said two or more membrane layers (1).
[Claim 2] Said porosity granular object (2) is a fiber cement board according to claim 1 constituted from one or more which are chosen from foaming pearlite milt balun, a vermiculite, and synthetic resin.

[Translation done.]

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(54) Title: A METHOD FOR PREPARATION OF A HARDENING COMPOSITION

(57) Abstract

A method for preparing concrete or mortar in which a mixture of a hydraulic binder, aggregates, water, and colloidal silica is prepared. The relative standard deviation of the particle size distribution by numbers of the colloidal silica is at least about 30 %. The invention also relates to concrete or mortar obtainable by the method.

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A method for preparation of a hardening composition

The present invention relates to a method for preparation of concrete or mortar having improved strength and durability properties. It also relates to concrete and mortar obtainable by the method, and to the use of said concrete, particularly as construction concrete, as well as to the use of said mortar.

Concrete is an artificial stone, commonly used as a building material, in which aggregates of suitable sizes are bound together by a matrix of a hydraulic binder. Usually the aggregates are stones, in the broad sense, and the hydraulic binder a cement. Concrete normally contains more aggregates than hydraulic binder, at least when calculated on volume basis. The aggregates commonly have a particle size distribution in the range of about 0.01 - 100 mm. In order to prepare concrete the aggregates and the hydraulic binder are mixed with water. Furthermore, concrete may contain certain additives such as setting and hardening additives, usually called accelerators, or workability additives, usually called superplasticiser. Mortar is distinguished by the maximum size of its aggregates: in general, mortar contains only aggregates with a maximum size of about 2-4 mm, e.g. sand. The concepts of cement, concrete, and mortar are furthermore extensively discussed in Ullman´s encyclopedia of industrial chemistry, 5th ed., Vol. A5, pp. 490-538, VCH, Weinheim, Germany 1986, hereby incorporated by reference. Below, mortar is comprised, for brevity´s sake, by the concept of "concrete".

One important property of concrete is obviously its strength. An important parameter controlling concrete strength is the water:cement ratio. Other factors are the type of cement, curing conditions, moisture content, degree of hydration of the cement, and the grading and shape of aggregates. If sufficient water is provided, the hydration of cement will continue over a period of several years, and concrete strength may increase continuously during this time. Conventionally, high strength is achieved by using a low water:cement ratio; superplasticisers are often used in this connection as they permit the use of lower water:cement ratios. Another way of improving the strength is to add silica fume, which is a pozzolanic waste material from silicon and ferrosilicon industries, having particle sizes of about 0.1-0.2 mm. Silica fume contains however unburnt coal, that gives the concrete a dark, usually undesired, colour, as well as other impurities, such as small quantities of metallic silicon that may cause explosion spalling of the concrete if it gets into contact with water.

Wagner and Hauck disclose in Hochsch. Archit. Bauwes. - Weimar 40 (1994) 5/6/7, pp. 183-7 the use of synthetically produced, chemically pure, and completely amorphous silica having an average particle size of 15 nm, which they call "nanosilica", instead of silica fume, which is referred to as "microsilica". The nanosilica particles are indicated to have specific surface areas in the range of 180 - 230 m^2/g, suggesting a rather narrow

particle size distribution; in this connection it should be said that according to "The Chemistry of Silica", Ralph K. Iler, Wiley & Sons 1979, pp. 346-7, hereby incorporated by reference, the specific surface area of silica may be transformed into the corresponding particle size, and vice versa, using the formula $2720/A_d = d_s$, where A_d is the specific surface area in m^2/g and d_s is the particle size in manometers. The impurity problems associated with silica fume are greatly overcome by the use of nanosilica. The concrete strength development is indicated to be about the same as if microsilica were used; the early strength development, i.e. from 1 to 7 days, is inferred by table 2 of the reference to be at most 36%. Agglomeration of the nanosilica is not discussed.

In EP-A2-0,519,155 a silica sol similar to nanosilica is used in shotcrete, primarily to provide the shotcrete with better cohesive properties, which in turn gives a lower degree of dust formation and rebound during the shotcreting. The cohesive effect is accomplished by promoting aggregation of the colloidal silica. The disclosed silica sol, which have particle sizes in the range of 7-40 nm and specific surfaces in the range of 50-700 m^2/g, shows a positive impact on the early strength compared to the effect of silica fume. The development of compressive strength from one to seven days is, in absence of accelerators, about 58%. Strength at later age is not mentioned. It has however been found (by the inventors of the present invention) that aggregation, i.e. gelling, coagulation, flocculation, or coarcevation, of the colloidal silica has a negative influence on the long term strength when compared to concrete in which silica fume is used, especially when higher doses of silica colloid are used, or if not mixed properly with the concrete mixture; this is probably due to encapsulation of the cement particles by the silica, which in turn is a hindrance to further hydration of the cement particles. No suggestion is given in EP-A2-0,519,155 about the particle size distribution.

The problem to be solved by the present invention is to provide a method for preparing concrete having enhanced early strength while having a good long term strength.

This problem is solved by the method defined by appended claim 1. According to this method, a mixture of an hydraulic binder, aggregates, water, and colloidal silica, is prepared, whereby the relative standard deviation of the particle size distribution of the colloidal silica is at least about 30%, preferably at least about 35%, and in particular at least about 40%. In this context "colloidal silica" means stable dispersions or sols of discrete particles of amorphous silica; this definition is the same as put forward in "The Chemistry of Silica" by Ralph K. Iler, page 312, Wiley & Sons 1979. The relative standard deviation of the particle size distribution is the ratio between the mean particle size by numbers and the standard deviation of the particle size distribution. "Variation coefficient" and "coefficient of variation" are terms synonymous to "relative standard deviation". The reason behind the positive effect of the broad particle size distribution on the strength para-

meters is not known, although a plausible hypothesis is that the smaller particles have a stabilising influence on the larger ones against aggregation.

The present invention has the additional advantages of providing concrete having good durability, especially against chemical attacks from, for instance, chlorides, sulphates, carbon dioxide, nitrogen oxides, and water. Furthermore, the obtained concrete has a high ultimate strength and good frost resistance. A particular advantage associated with the present invention is that the final concrete products have a most homogeneous and uniform strength.

The hydraulic binder is preferably a portland cement.

Preferably, the silica particles used in the present method have an average specific surface area below about 200 m^2/g, in particular below about 180 m^2/g, and preferably in the range of about 50-170 m^2/g. Above 200 m^2/g it becomes increasingly difficult to counteract aggregation.

It is also preferred that the silica particles used in the present method have a particle size distribution the standard deviation of which is at least about 20 nm. The particle size distribution may be monomodal, i.e. have one particle size with a higher frequency of occurrence than the immediately adjacent sizes, or be polymodal, i.e. have two or more such particle sizes.

The silica particles preferably have a mean particle size by numbers of about 7-50 nm, particularly of about 10-30.

In the present method the particles are preferably added in form of an aqueous suspension containing about 8-60 percent by weight, in particular about 30-50 percent by weight, of silica. The particles are generally of a size of about 5-200 nm, preferably 10-100 nm, and they are preferably added to the mixture in an amount of about 1-8 percent by weight, in particular about 1-5 percent by weight, and especially about 2 percent by weight, calculated on the weight of the hydraulic binder. According to a preferred embodiment of the present invention the method also includes addition of a superplasticiser. Any suitable superplasticiser may be used, but it is preferred that it comprises a sulphonated naphthalene-formaldehyde resin, a sulphonated melamine-formaldehyde resin, or a sulphonated melamine-urea-formaldehyde resin, or a mixture thereof. Exemplary of useful superplasticiser are those disclosed in WO 91/12214 and EP 692,465, both of which are hereby incorporated by reference.

A part or all of the superplasticiser is preferably added to the concrete mixture before the colloidal silica, as this way of adding has shown to have a stabilising effect on the colloidal silica. In a particularly preferred embodiment of the present method about 35-

55 percent by weight, preferably about 55 percent by weight, of the superplasticiser, based on the total amount of superplasticiser, is added before the colloidal silica.

The colloidal silica need not be stabilized by any stabilizing agent. It could, for instance, be silica sol prepared by the ion-exchange method as set forth in "The Colloid Chemistry of Silica", Horacio E. Bergna (Ed.), American Chemical Society 1994. Preferably, however, the colloidal silica is stabilized, in particular with alkaline substances, advantageously by ions of alkaline metals, e.g. of Na, K, or Li, or by ammonium ions (NH_4), or a combination thereof. In a preferred embodiment the amount of stabilizing alkaline substance is governed by a molar ratio SiO_2:M_2O of from about 150:1 to about 300:1, whereby M represents Na, K, Li, or NH_4.

Accelerators, such as conventionally used in shotcrete, are preferably not used, or only used in insignificant amounts, when preparing concrete according to the present method.

According to a preferred embodiment of the present invention, concrete is prepared by mixing about 100 parts by weight of hydraulic binder; about 100-1000 parts by weight of aggregates; up to about 5 parts by weight of colloid silica; up to about 5 parts by weight of superplasticiser; and about 25-75 parts by weight of water.

The present invention also relates to concrete obtainable by the method according to the present invention as set forth above. According to one embodiment of the present invention concrete obtainable by said method is preferably used as construction concrete, which concept in the present context does not comprise shotcrete. The concept of "concrete" also comprises special concretes such as heavyweight concrete, lightweight concrete, fibre-reinforced concrete, and massive concrete.

Below, the present invention is illustrated by means of non-limiting examples.

Example 1: An anionic silica sol stabilized with NH_4^+ and containing less than 0.05% of Na_2O was used. The specific surface area was 80 m^2/g, the mean particle diameter by numbers was 35 nm with a standard deviation by numbers of 25 nm, i.e. the relative standard deviation was 71%. 95% by numbers of the particles had a size within the range from 5-150 nm. The silica sol was present as a dispersion containing 40 percent by weight of the solid particles, based on the dispersion. A mixture was prepared of 500g standard portland cement, 1500g standard sand 1,2,3, 7.5g superplasticiser "Mighty 100", which is a sulphonated naphthalene formaldehyde condensate available from the Japanese company Kao Chemicals, and 62.5g of the silica sol dispersion, whereby 50% of the total added amount of superplasticiser was added to the mixture before addition of the silica sol. The water:cement ratio was 0.4. Fresh density was 2195 kg/m^3, and 4x4x16 cm mortar prism samples were cast. The samples were cured for one day in steal frames, five days in water, and later in a climate room at 20°C and 55% RH. The flexural and com-

pressive strengths were measured after one, three, and seven days, by means of standard methods SS 13 42 33 and SS - EN 196.1, respectively. The results are set forth in Table I below.

Table I

Days	Flexural strength, MPa	Compressive strength, MPa
1	5.4	30.7
3	8.8	40.2
7	6.5	50.7
strength development in 1-7 days, %	20	65

As can be seen in Table I the development of compressive strength from one to seven days clearly surpasses the development suggested in EP-A2-519,155; in fact even the actual compressive strength is higher.

Example 2 Mortars were made with different amounts of an anionic colloidal silica sol containing 0.22% of Na_2O. The specific surface area of the silica particles was 80 m^2/g, the mean particle diameter by numbers was 62 nm with a standard deviation by numbers of 28 nm, i.e. the relative standard deviation was 45%. 95% by numbers of the particles had a size within the range of 62 nm +/- 56 nm. The silica sol was present as a dispersion containing 50 percent by weight of the solid particles. The mortars has cement:sand ratios of 1:3. Standard portland cement, supplied by Cementa AB, Slite, Sweden, and standard sand, grade 1, 2, and 3 were used. Mighty 100 was used as superplasticiser in an amount of 1.5 percent by weight, based on the weight of the cement; about 50% of the plasticiser was added before the colloidal silica sol was added. Table II below shows the weight percentages of silica sol, based on the cement, together with the water:cement ratios, the fresh densities, the air contents, and the consistencies, of the various mortars

Table II					
No.	silica sol, %	w/c ratio	fresh density, kg/m^3	air, %	consistency, mm
KF3	3	0.41	2300	3.02	135
KF5	5	0.43	2220	5.9	130
KF8	8	0.46	2260	4.70	130

Prisms having the dimensions 4x4x16 cm were cast of the mortars according to Table II. They were demoulded after 1 day, cured in water for 5 days, and in a climate room at 55% RH and 22°C for 22 days. Flexural and compressive strengths were measured after 1, 7, and 28 days, by means of standard method SS 1342 33 and SS-EN 196-1, respectively. The results, given in MPa, are set forth in Table III below.

Table III			
	KF3	KF5	KF8
Compressive strength, 1 day	31.4	33.2	22.3
7 days	51.7	53.0	51.5
28 days	63.7	61.7	64.8
Flexural strength, 1 day	5.88	6.18	4.31
7 days	9.32	9.41	7.26
28 days	12.7	12.1	10.3

Regarding early strength, i.e. in 1-7 days, the best results were evidently obtained with mortar KF5.

KF5 was subjected to some durability test. Chloride-ion penetration was measured by means of a method described in an article by Tang et al. entitled "Rapid determination of chloride diffusivity in concrete applying an electric field", Material Journal, Vol. 89, No. 1, page 49, The American Concrete Institute 1992, hereby incorporated be reference.

and the diffusion coefficient regarding chloride-ion penetration for KF3 was determined to $3.13x10^{-12}$ m^2/s, whereas a reference sample with no silica sol added showed a diffusion coefficient of $11.1x10^{-12}$ m^2/s. The carbonation depth was measured by spraying phenolphthalein on a fresh broken surface, substantially perpendicular to the surface of the sample, and measuring the length of penetration indicated by the phenolphtalein. The KF3 sample showed a penetration depth of 1.49 mm after 225 hours, while a reference sample with no silica sol added showed a penetration depth of 12.2 mm after an equally long period of time. Freeze-thaw salt resistance was determined by freezing a KF3 mortar prism in a saturated NaCl solution at -20°C for 16 hours ant then thawing it in water at ambient temperature for 8 hours. This freeze-thaw sequence was repeated a number of times, whereby each sequence was denominated "a cycle". The freeze-thaw salt resistance was estimated on basis of the weight change of the prisms after certain numbers of cycles. A reference prism with no silica sol added showed a weight loss of 20% after 11 cycles, and after 16 cycles it was broken. The KF3 prism, however, instead showed a weight gain (due to absorption of the salt solution) of about 0.3% at 16 cycles, and even at 35 cycles there was not any noticeable weight loss.

Claims

1. A method for preparing concrete or mortar, characterised in that it comprises preparing a mixture of a hydraulic binder, aggregates, water, and colloidal silica, wherein the relative standard deviation of the particle size distribution by numbers of the colloidal silica is at least about 30%.

2. A method according to any preceding claim, characterised in that the silica particles have an average specific surface area below about 200 m^2/g.

3. A method according to claim 2, characterised in that the particles have an average specific surface area of from about 50 to about 170 m^2/g.

4. A method according to any preceding claim, characterised in that the silica particles have a particle size distribution with a standard deviation of at least about 20 nm.

5. A method according to any preceding claim, characterised in that the silica particles have a mean particle size by numbers of from about 7 to about 50 nm.

6. A method according to any preceding claim, characterised in that the particles are added with an aqueous suspension containing from about 15 to about 50 percent by weight of silica.

7. A method according to any preceding claim, characterised in that the particles are added in an amount of from about 1 to about 8 percent by weight, calculated on the hydraulic binder.

8. A method according to any preceding claim, characterised in that the preparation of the mixture includes addition of a superplasticiser.

9. A method according to claim 8, characterised in that part of the superplasticiser is added to the mixture before the silica particles.

10. A method according to claim 9, characterised in that said part of plasticiser is from about 35 to about 55 weight-% based on the total amount of superplasticiser added.

11. A method according to any preceding claim, characterised in that the superplasticiser comprises a sulphonated naphthalene-formaldehyde resin, a sulphonated melamine-formaldehyde resin, or a sulphonated melamine-urea-formaldehyde resin.

12. A method according to any preceding claim, characterised in that the silica particles are stabilized against aggregation by means of alkali metal ions or ammonium ions.

13. A method according to any preceding claim, characterised in that no or only an insignificant amount of accelerator is added to the mixture.

14. A method according to any preceding claim, characterised in that the concrete or mortar is prepared by mixing about 100 parts by weight of hydraulic binder;

from about 100 to about 1000 parts by weight of aggregates; up to about 5 parts by weight of colloid silica; up to about 5 parts by weight of superplasticiser; and from about 25 to about 75 parts by weight of water.

15. Concrete or mortar obtainable by the method according to any preceding claim.

16. Concrete or mortar according to claim 15, with the proviso that it is not shotcrete.

17. Concrete or mortar according to claim 15 or 16, characterised in that it is construction concrete.

18. Concrete or mortar according to anyone of claims 15-17, characterised in that it is mortar.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01350

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C04B 22/06 // C04B 24/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO:WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1495811 A (AB ALFONG BETONGHARDNINGSMEDEL & CO., KOMMANDITBOLAG), 21 December 1997 (21.12.97), page 1, line 20 - line 34 -- --------	1-18

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 1997	19 -11- 1997
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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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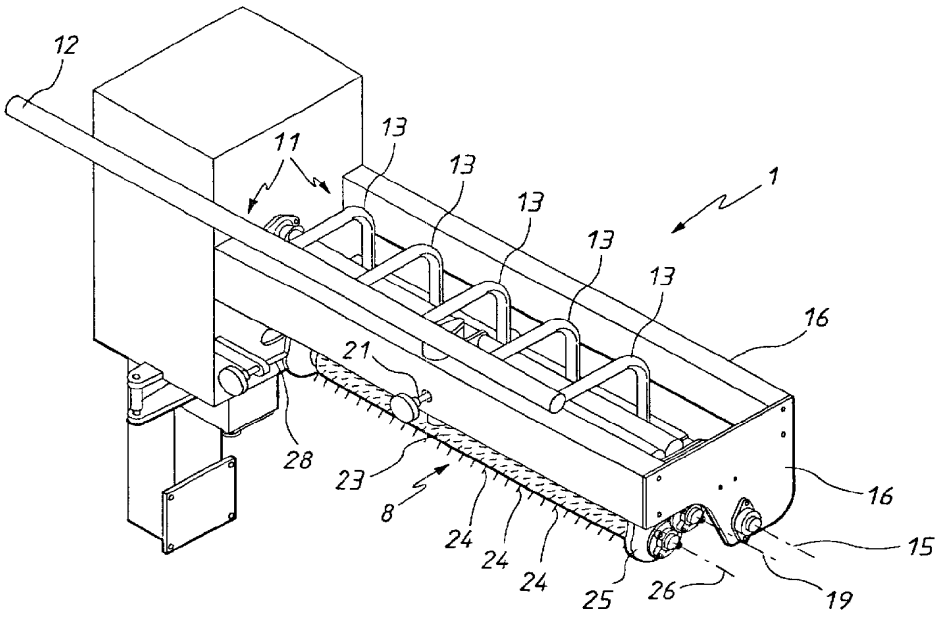
[Continued on next page]

(54) Title: SPATTERING APPARATUS



(57) Abstract: An apparatus (1) for applying a slurry to a substrate (2). The apparatus includes a delivery drum (4) incorporating a delivery surface (5) disposed to support a layer of slurry. A spattering roller (8) is positioned closely adjacent the delivery drum and is rotatable so as to spatter the slurry from the delivery surface onto the substrate. Regulation means selectively vary or inerrupt vary or interrupt the flow of slurry from the delivery surface onto the substrate.

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(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE: SPATTERING APPARATUS

FIELD OF THE INVENTION

This application claims priority from the following Australian provisional patent applications, the full contents of which are hereby incorporated by cross-reference.

Application No.	Title	Date Filed
PR3474	A Composite Product	02 March 2001
PR3475	Spattering Apparatus	02 March 2001
PR3476	Additive For Dewaterable Slurry	02 March 2001
PR3477	A Method And Apparatus For Forming A Laminated Sheet Material By A Spattering	02 March 2001
PR3478	Coatings For Building Products	02 March 2001

The present invention relates to an applicator for a fluent substance, and in the preferred form to an apparatus for applying a slurry to a substrate, by spattering.

The invention has been developed primarily for use in relation to the production of fibre reinforced cement (FRC) sheet from cementitious slurry, and will be described primarily with reference to that application. However, it will be appreciated that the invention is not limited to this particular field of use.

BACKGROUND OF THE INVENTION

The following discussion of the prior art is intended to present the invention in an appropriate technical context and allow the significance of it to be properly appreciated. Unless clearly indicated to the contrary, however, reference to any prior art in this specification should not be construed as an admission that such art is widely known or forms part of common general knowledge in the field.

Various apparatus for applying liquids to substrates are known. For example, one process makes use of a spray bar whereby a liquid coating, such as a paint or primer, is squirted and atomised through spaced apart nozzles, so as to coat the substrate which typically passes progressively beneath the spray bar on a conveyor. One problem with devices of this type is that the relatively fine nozzles required to achieve the degree of atomisation necessary for uniform coating are readily clogged,

particularly in the case of slurries containing a solid component in suspension. This results in inconsistent application, and requires frequent cleaning which is time consuming, costly and disruptive to the production process. Atomisation is also problematic in the case of more viscous liquids and slurries.

Another known device is a curtain coater, which makes use of a sheet or curtain of flexible fabric material which drapes over the moving substrate and applies a coating by means of a direct wiping action. However, curtain coaters are prone to inconsistent application, are not well suited for use with slurries, are limited in terms of the speed at which they can operate effectively in a production environment, and are not well adapted to applying relatively thick coatings.

Another known form of applicator is usually referred to as a flood coater, which essentially operates by forming a pool of liquid on the substrate, and spreading the pool over the surface with air jets. Again, however, there are limitations with this technique in terms of the uniformity of application, the viscosity of the liquid or slurry that can be used, and the thickness of the layer or coating that can be applied.

Generally, therefore, these known forms of apparatus are subject to a variety of limitations including susceptibility to clogging, inconsistent application, limitations in speed, limitations in the width of sheet material that the coating can be applied to, limitations in the consistency of the liquid or slurry that can be applied, or some combination of one or more of these shortcomings. They are also typically adapted to apply relatively thin outer surface coatings, as distinct from intermediate layers of substantial thickness as part of a laminated sheet. These limitations render such prior art devices generally unsuitable for use in the manufacture of sheet materials, and particularly FRC sheets, of substantial size and at relatively high speed.

Another known form of apparatus is a spatter coater, which makes use of a rotating roller incorporating a radial array of flexible filaments or bristles to spatter a coating onto a substrate. Spatter coaters are used, for example, to apply surface coatings to clay or masonry tiles, on a production line. Spatter coaters are able to some extent to overcome some of the deficiencies of the other known forms of coating apparatus, especially in terms of clogging. However, in the context of the production of sheet material, known spatter coaters are also subject to inherent limitations.

In particular, known spatter coaters are not able accurately to stop and restart the application process on an intermittent basis, in order to permit precisely controlled coating or laminating. This is especially so with the types of slurries typically used in the production of FRC sheet, because of the relatively runny consistency required to ensure "self-levelling", and the consequential tendency for excess slurry to drip onto the substrate, even if the slurry supply is shut off or the spattering roller is temporarily stopped.

This precise control over intermittent stopping and starting of the application process is particularly important in a high speed production environment where different batches of sheets, having different layers, thicknesses or properties, may be required to run back to back through the coating apparatus and inaccurate transitional control can result in patchy application, or the coating for one batch running over into the following batch of product.

A further difficulty arises due to the fact that, in the manufacture of FRC sheet or other products using cementitious slurries, it is desirable not to stop the supply of slurry to the apparatus itself, as this can result in the stagnation or accumulation of slurry in the apparatus or in upstream parts of the process. This, in turn, can result in overflows, changes in slurry consistency or concentration, settling or sedimentation, or undesirable variations in other process parameters.

Known spattering apparatus do not provide for the precise interruption of the slurry application process, and also do not allow for interruption without stopping the supply of slurry to the apparatus. They are therefore not effective in enabling an accurately controlled intermittent application process, especially in a high speed production environment for sheet materials.

It is an object of the present invention to overcome or ameliorate one or more of the disadvantages of the prior art, or at least to provide a useful alternative.

SUMMARY OF THE INVENTION

Accordingly, the invention provides an apparatus for applying a slurry to a substrate, the apparatus including:

a delivery surface disposed to support a layer of slurry;

spattering means adapted to be positioned closely adjacent the delivery surface and being movable so as to spatter the slurry from the delivery surface onto the substrate; and

regulation means for selectively varying or interrupting the flow of slurry from the delivery surface onto the substrate.

The terms "spatter", "spattering" and the like as used herein, are intended to encompass any application technique whereby the slurry is deposited onto a surface or substrate in droplet, globule, particulate or atomised form, whether produced by brushing, flicking, rotating, spraying, agitating, atomising or other dispersion means, and whether propelled by mechanical, electrostatic, hydrostatic, hydrodynamic, gravitational or other means.

Unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Preferably, the apparatus includes a reservoir to contain slurry upstream of the regulation means. Preferably, the reservoir includes an inlet to direct slurry from a supply source and an outlet associated with the regulation means.

The regulation means preferably include a pair of barrier elements selectively movable to define an intermediate clearance space of variable effective cross-sectional flow area, thereby to permit selective regulation of the flow rate of slurry from the reservoir, between the barrier elements, through the outlet, to the delivery surface. Preferably, the barrier elements are selectively adapted, in a closed configuration, to shut off flow between the reservoir and the delivery surface.

Preferably, one of the barrier elements comprises a first cylindrical roller rotatable about a first axis. The other of the barrier elements is preferably a second cylindrical roller rotatable about a second axis, parallel to the first. The rollers are preferably configured to rotate in opposite directions.

The first roller preferably takes the form of a delivery drum, the outer surface of which constitutes the delivery surface. The second roller preferably takes the form of a metering roller selectively movable toward, and away from, the delivery drum.

The apparatus preferably includes a main frame supporting the delivery drum, and a first sub-frame on which the metering roller is mounted, the first sub-frame being rotatable about a third axis parallel to, and spaced from, the second axis, thereby adjustably to displace the metering roller towards, and away from, the delivery drum while maintaining a parallel orientation between them.

In one preferred embodiment, the apparatus includes first hydraulic or pneumatic actuation means extending between the main frame and the first sub-frame for adjustably moving the metering roller and the delivery drum toward or away from each other.

Preferably, the spattering means include a plurality of resiliently flexible elongate spattering elements in the form of bristles, extending radially outwardly from a cylindrical body rotatable about a fourth parallel axis. The body and spattering elements together preferably form a spattering roller.

The apparatus preferably further includes a second sub-frame on which the spattering roller is mounted, the second sub-frame being rotatable about a fifth axis substantially parallel to, and spaced apart from, the fourth axis. A second actuator preferably extends between the main frame and the second sub-frame to effect independently adjustable displacement of the spattering roller towards, and away from, the delivery drum, so as to permit selective variation or interruption of the spattering process, as part of the regulation means.

Preferably, the apparatus further includes a tank for containing a supply of the slurry and a delivery conduit for delivering the slurry from the tank to the reservoir through the inlet.

In one embodiment, the reservoir is defined by a tank positioned immediately above the delivery and metering rollers. In an alternative embodiment, the reservoir is simply a containment region defined between adjacent rollers, preferably the delivery roller and an abutting idler roller, with the metering roller being positioned above the delivery roller.

In a preferred embodiment, the slurry is a cementitious slurry and more preferably, is formed from a mixture of silica, cement, water and optionally other additives.

The apparatus is particularly suitable for applying aesthetic or functional coating layer to an existing substrate. In one embodiment, the slurry is a self levelling dewaterable cementitious slurry with a solids content of between 50% and around 90%. The slurry preferably includes a dewatering aid in a sufficient quantity to permit dewatering of the slurry, preferably through the substrate with or without vacuum assistance.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawing in which:

Figure 1 is a perspective view of an apparatus in accordance with the invention;

Figure 2 is a diagrammatic side elevation of the apparatus of Figure 1;

Figure 3 is a schematic side elevation of the apparatus of Figure 1; and

Figure 4 is a schematic, side elevation showing an alternative embodiment of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring initially to Figures 1 to 3, the invention provides an apparatus 1 for applying a cementitious slurry to a substrate 2 in the form of a laminated sheet material in the process of being manufactured. In broad terms, the apparatus 1 includes an elongate reservoir 3 for containing the slurry, and a delivery drum 4 having an outer delivery surface 5 for supporting an adherent layer of the slurry from the reservoir by surface tension. Regulating means 6 including a cylindrical metering roller 7 are adapted to selectively regulate the flow rate of slurry from the reservoir to the delivery surface, and a spattering roller 8 is disposed to spatter the slurry from the delivery surface onto the substrate. These features of the invention are described in more detail below.

At the top of the reservoir 3, there are a number of inlets 9 to direct slurry from a supply source in the form of a five hundred litre main slurry holding tank 10 (see Figure 3) positioned below the level of the apparatus. The slurry is delivered by a pump (not shown) to the reservoir from the main tank via a manifold 11. The manifold includes a header pipe 12 in fluid communication with the main tank 10, and a number of parallel delivery pipes 13 leading from the header pipe, through the inlets 9, into the reservoir to deliver the slurry as indicated by arrows A in Figure 3. An overflow pipe 14 is connected between the reservoir and the main tank for recirculating slurry above a predetermined level in the reservoir back to the tank, as indicated by arrow B, to prevent overflow.

The delivery drum 4 is essentially a cylindrical roller mounted for rotation in a direction indicated by arrow C, about a first axis 15 on a main frame 16. The drum 4 is disposed below the reservoir and is parallel to but longitudinally offset relative to the centre line of the reservoir. The drum is disposed under an outlet 17 of the reservoir, and is therefore in the path of slurry flowing downwardly from the reservoir, as indicated by arrow D. Thus, slurry from the reservoir flows directly onto the delivery surface 5.

The delivery drum 4 operates in conjunction with the metering roller 7 to define the outlet and to form part of the regulation means 6 referred to above. The metering roller 7 is mounted on a first sub-frame 18 for rotation, in a direction indicated by arrow E, about a second axis 19 which is parallel to the first axis 15. The

sub-frame 18, in turn, is mounted on the main frame 16 for rotation about a third axis 20 which is parallel to the second axis 19. The delivery drum and the metering roller are rotationally driven in opposite directions by a motor, via a chain drive assembly (not shown). Both the delivery drum and the metering roller are plated with chrome to provide the desired surface hardness. In alternative embodiments, however, the drum and roller may be additionally or alternatively coated with polyurethane, carbide, or other suitable surface coatings, treatments or finishes.

An actuation mechanism including a ram 21 is provided for adjustably rotating the first sub-frame 18 so that the metering roller 7 moves towards, or away from, the delivery drum, as indicted by arrow F. It will therefore be appreciated that the delivery drum and the metering roller serve as a pair of barrier elements, adjustably defining an intermediate clearance space 22 for channelling or blocking the flow of slurry from the reservoir to the surface of the delivery drum. Thus, movement of the metering roller towards, or away from, the delivery drum varies the effective cross-sectional area of the clearance space 22, and this movement therefore regulates the flow rate of the slurry onto the delivery surface. In the embodiment shown, the ram 21 includes a screw and is actuated by rotation. In other embodiments (not shown), the ram may pneumatic or hydraulic.

The spattering roller 8 includes a cylindrical body 23 and a plurality of resiliently flexible elongate spattering elements in the form of bristles 24 which extend radially outwardly from the body. The spattering roller is mounted on a second sub-frame 25 for rotation about a fourth axis 26, parallel to the other axes. The second sub-frame 25, in turn, is mounted on the main frame 16 for rotation about a fifth parallel axis 27. A second ram 28, is provided for rotating the second sub-frame 25 about its axis 27, and hence for adjustably moving the spattering roller 8 towards, or away from, the delivery drum 4 as indicated by arrow G. The spattering roller 8 is rotationally driven by a motor via a V-belt and pulley assembly (not shown).

An overflow sump 29 is provided at the bottom of the apparatus and is positioned to catch overflow slurry from the reservoir, which falls from or between the metering roller and delivery drum, without being picked up by the spattering roller 8.

In use, the apparatus is disposed across a conveyer (not shown) which forms part of a production line for sheeting to be formed from, or incorporate, a layer of

material formed from the slurry. The sheet may or may not be fibrous and laminated. However, it is envisaged that the invention will ideally be used in relation to the manufacture of laminated fibre reinforced cement (FRC) sheet and in that context, may be incorporated into the known "Hatschek" process.

As the sheet passes beneath on the conveyer, the apparatus is activated and slurry is permitted to flow downwardly from the reservoir onto the rotating delivery drum 4. The spattering roller 8 also rotates whereby the bristles 24 are dragged over the delivery drum, to collect slurry from the layer formed on the delivery surface of the drum. When the bristles move clear of the delivery drum, they flick the slurry and spatter it onto the sheet below, to apply a relatively uniform layer of slurry.

The distance between the metering roller and the counter-rotating delivery drum determines the effective cross-sectional flow area of the intermediate clearance space 22 and hence the flow rate of the slurry onto the drum. This, in turn, determines the thickness of the layer of slurry formed on the delivery surface which also affects the rate of spattering of the slurry by the spattering roller. This thickness can be adjusted as desired by means of the ram 21 to be appropriate for the particular formulation of slurry being used, to achieve the desired thickness of the spattered layer.

In addition to adjusting the cross-sectional area of the clearance space 22, the spattering characteristics can also be varied by moving the spattering roller 8 towards, or away from, the delivery drum using the second ram 28. This varies the extent to which the bristles penetrate the slurry layer on the delivery surface, pressure of the bristles 24 on the delivery surface, and the extent of resilient deformation of the bristles to provide an added dimension of control. Further adjustment and control can be achieved by varying the speed of the spattering roller, both in absolute terms and relative to the delivery roller. By altering these various operational parameters which also broadly constitute aspects of the regulation means, different thicknesses, up to around 10 mm or more, can be achieved in single, intermediate or surface layers. Different surface finishes such as orange peel, stucco and the like can also be achieved.

The second sub-frame 25 is capable of rotating sufficiently about its axis 27 to allow the spattering roller to move well clear of the delivery drum. This enables

accurate stopping and starting of the application process as described in more detail below, as well as facilitating cleaning and maintenance of the spattering roller and the drum.

It will be appreciated that some of the slurry flowing from the reservoir lands on, and is carried round by, the metering roller 7 rather than the delivery drum. This slurry, as well as other slurry passing through the outlet which is not picked up by the spattering roller, falls from the metering roller as overflow into the sump 29, from where it is fed, by gravity, back to the supply tank 10.

One embodiment of the apparatus is adapted to be used on a production line on which sheets having different characteristics and constituent layers are produced in quick succession. Consequently, it is necessary to be able to pause and restart the spattering process, and adjust the slurry flow rate, rapidly and accurately to prevent a carry-over of the spattering conditions in respect of one type of sheet to the type of sheet passing along the production line.

To this end, adjustment of the flow rate is achieved by moving the metering roller relative to the delivery drum, so as to adjust the intermediate clearance space 22. To temporarily stop the spattering process, the spattering roller is intermittently moved away from the delivery roller. In this way, the spattering roller also forms part of the flow regulation means. Additionally or alternatively, the metering roller may simply be moved until it abuts the delivery drum directly, so as to completely close the clearance space 22, thereby cutting off the supply of slurry to the deliver surface, through the associated outlet.

During this process, it is desirable not to stop or reduce the rate of delivery of slurry from the main supply tank 10 to the reservoir 3, as this may have disadvantageous consequences including overflows, changes in slurry consistency or concentration, settling or sedimentation, upsetting of other process parameters, or clogging of piping which in turn may interrupt the production process, and necessitate labour-intensive maintenance and cleaning operations. Accordingly, when the spattering process is paused, resulting in the flow rate of slurry from the reservoir being reduced or stopping completely, the level of slurry in the reservoir may increase. Once it reaches the level of the overflow pipe 14, the overflow slurry is returned through this pipe back to the main tank. Thus, in pause mode, the slurry

continues to circulate between the tank and the reservoir, to prevent settling, clogging or overflowing until delivery resumes.

Figure 4 is a schematic view showing a further embodiment of the invention, wherein corresponding features are denoted by corresponding reference numerals. In this case, a separate tank for the reservoir is not used. Rather, the reservoir simply takes the form of an open topped containment region 30 defined between the delivery roller 4 and an adjacent idler roller 32 positioned in rolling contact, and in side by side relationship, with respect to the delivery roller. The idler roller is coated with polyurethane and is not driven. The height and diameter of the idler roller are configured such that the slurry in the containment region flows naturally into the clearance space 22 between the delivery roller 4 and the metering roller 7, which in this embodiment is positioned immediately above the delivery roller. An additional collection tray 34 is provided to collect any slurry dripping from the idler roller, and feed it back to the main tank 10 via the overflow conduit 14 for recirculation. In most other respects, this embodiment functions in essentially the same way as that previously described.

The apparatus may be positioned at any desired point along the process line, and may be selectively operated on an intermittent basis at any desired time in the process, in order to position the spattered layer or layers appropriately. For example, the spattered layer may be initially applied to the belt as a first layer of film, so as to form what will ultimately be an outer layer of the finished sheet. This may be done, for example, in a case where the outer spattered layer will comprise a softer formulation to facilitate sanding and finishing, a coloured formulation for branding or to obviate the need for painting, or a textured layer to achieve a desired aesthetic effect. The same considerations might apply in the case where the spattered layer is the final layer in which case, again, it will form an outer face of the finished sheet. Alternatively, the spattered slurry may be applied at an intermediate stage to form an internal layer. This may be done, for example, in the case of a fire retardant layer, a moisture barrier layer, or a layer added for structural purposes, where surface finish or aesthetic considerations are not directly relevant. It should also be appreciated that the entire sheet may be formed by spattering, either as a single uniform layer, or from multiple spattered layers of the same or different composition. In this context, it will

further be appreciated that a series of the spattering devices may be positioned in sequence along a process line using either the same or different slurry formulations. It should also be understood that the sheet material may include layers formed previously or simultaneously by other processes. Furthermore, the apparatus may be used to apply a paint primer, render, sealant or other surface coating, whether cementitious in composition or otherwise.

The invention provides an effective and efficient method and apparatus for producing sheet material. In its preferred application in the manufacture of FRC, it provides a means of accurately producing a laminated sheet material which can be readily tailored and optimised in order to achieve a wide variety of performance and aesthetic characteristics. The apparatus also allows the application characteristics to be readily altered, providing a considerable degree of flexibility to produce a range of different products, including laminated products, on an effectively continuous basis, with minimum set up time between runs. In all these respects, the invention represents a practical and commercially significant improvement over the prior art.

Although the invention has been described with reference to specific embodiments it will be appreciated by those skilled in the art that it may be embodied in many other forms. In particular, it will be appreciated that the method and apparatus of the present invention may be adapted for use in conjunction with the composite product, additive for dewaterable slurry, and coatings for building products as described in the various priority documents.

CLAIMS

1. An apparatus for applying a slurry to a substrate, the apparatus including:

a delivery surface disposed to support a layer of slurry;

spattering means adapted to be positioned closely adjacent the delivery surface and being movable so as to spatter the slurry from the delivery surface onto the substrate; and

regulation means for selectively varying or interrupting the flow of slurry from the delivery surface onto the substrate.

2. An apparatus according to claim 1, further including a reservoir to contain slurry upstream of the regulation means.

3. An apparatus according to claim 2, wherein the reservoir includes an inlet to direct slurry from a supply source and an outlet associated with the regulation means.

4. An apparatus according to any one of the preceding claims, wherein the regulation means include a pair of barrier elements selectively movable to define an intermediate clearance space of variable effective cross-sectional flow area, thereby to permit selective regulation of the flow rate of slurry from the reservoir, between the barrier elements, through the outlet, to the delivery surface.

5. An apparatus according to claim 4, wherein the barrier elements are selectively adapted, in a closed configuration, to shut off flow between the reservoir and the delivery surface.

6. An apparatus according to claim 4 or claim 5, wherein one of the barrier elements comprises a first cylindrical roller rotatable about a first axis.

7. An apparatus according to claim 6, wherein another of the barrier elements is a second cylindrical roller rotatable about a second axis, parallel to the first.

8. An apparatus according to claim 7, wherein the first and second rollers are configured to rotate in opposite directions.

9. An apparatus according to claim 8, wherein the first roller takes the form of a delivery drum, an outer surface of which constitutes the delivery surface, and the second roller takes the form of a metering roller selectively movable toward, and away from, the delivery drum.

10. An apparatus according to claim 9, further including a main frame supporting the delivery drum, and a first sub-frame on which the metering roller is mounted, the

first sub-frame being rotatable about a third axis parallel to and spaced apart from the second axis, thereby adjustably to displace the metering roller towards, and away from, the delivery drum while maintaining a parallel orientation therebetween.

11. An apparatus according to claim 10, further including first actuation means extending effectively between the main frame and the first sub-frame for adjustably moving the metering roller and the delivery drum toward or away from each other.

12. An apparatus according to claim 11, wherein the first actuation means include a hydraulic or pneumatic cylinder.

13. An apparatus according to any one of claims 1 to 12, wherein the spattering means include a plurality of resiliently flexible elongate spattering elements in the form of bristles, extending radially outwardly from a cylindrical body rotatable about a fourth axis.

14. An apparatus according to claim 13, when dependent upon claim 10, wherein the fourth axis is generally parallel to the first, second and third axes.

15. An apparatus according to claim 13 or claim 14, wherein the body and the spattering elements together form a spattering roller.

16. An apparatus according to claim 15, further including a second sub-frame on which the spattering roller is mounted, the second sub-frame being rotatable about a fifth axis substantially parallel to, and spaced apart from, the fourth axis.

17. An apparatus according to claim 16, wherein second actuation means extend effectively between the main frame and the second sub-frame to effect independently adjustable displacement of the spattering roller towards, and away from, the delivery drum, so as to permit selective variation or interruption of the spattering process, as part of the regulation means.

18. An apparatus according to claim 17, wherein the second actuation means include a hydraulic or pneumatic cylinder.

19. An apparatus according to any one of claims 9 to 18, further including a tank for containing a supply of the slurry and a delivery conduit for delivering the slurry from the tank to the reservoir through the inlet.

20. An apparatus according to claim 19, wherein the reservoir is defined by a tank positioned immediately above the delivery drum and the metering roller.

21. An apparatus according to claim 19, wherein the reservoir comprises a containment region defined between adjacent rollers.

22. An apparatus according to claim 21, wherein the containment region is defined between the delivery drum and an abutting idler roller, with the metering roller being positioned above the delivery roller.

23. An apparatus according to any one of the preceding claims, being adapted for use with a cementitious slurry formed from a mixture of silica, cement, water and optionally other additives.

24. An apparatus according to claim 23, wherein the cementitious slurry is a self levelling dewaterable slurry with a solids content of between 50% and around 90%.

25. An apparatus according to claim 24, wherein the slurry includes a dewatering aid in sufficient quantity to permit dewatering of the slurry, through an underlying substrate.

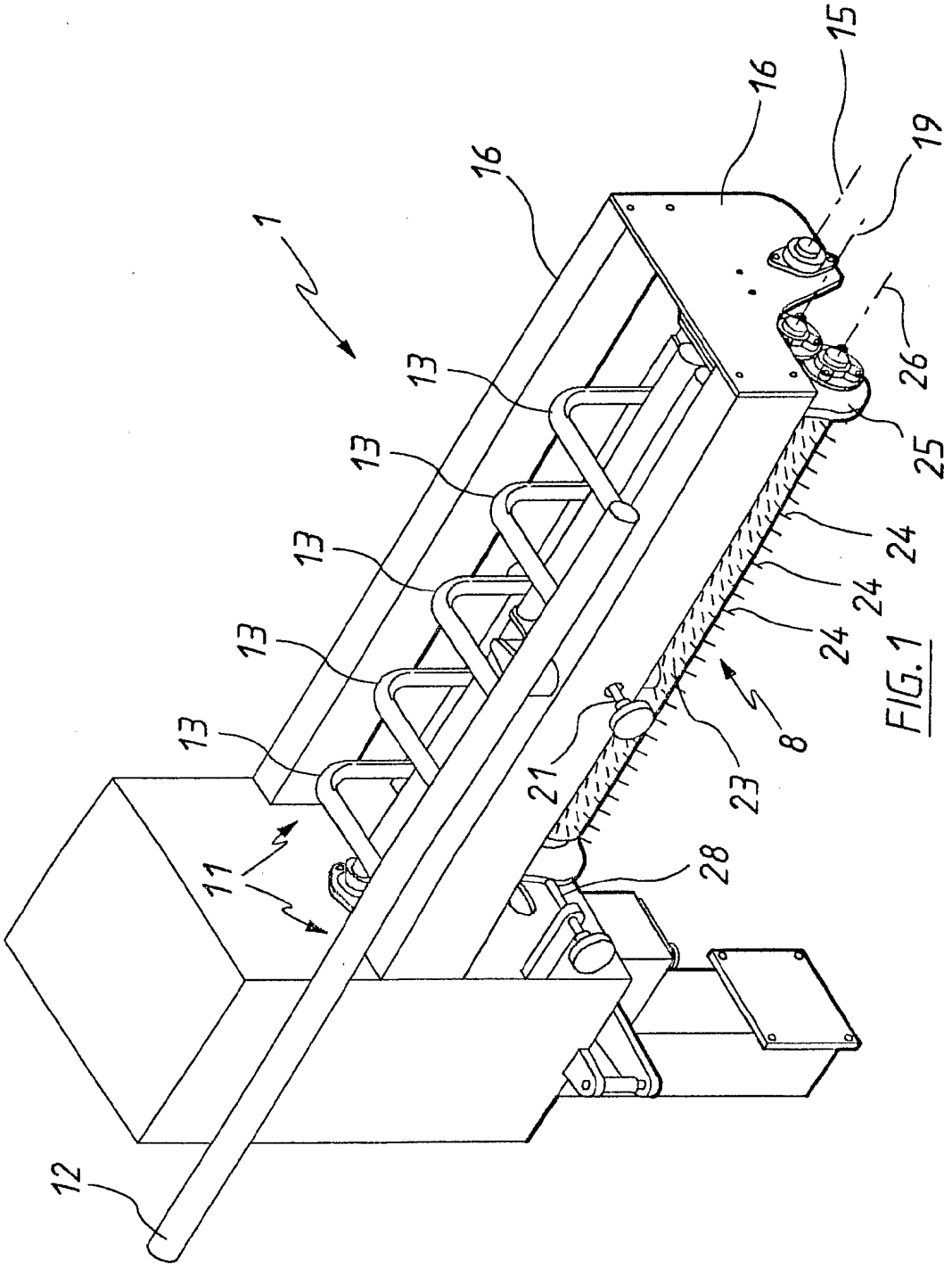

FIG. 1

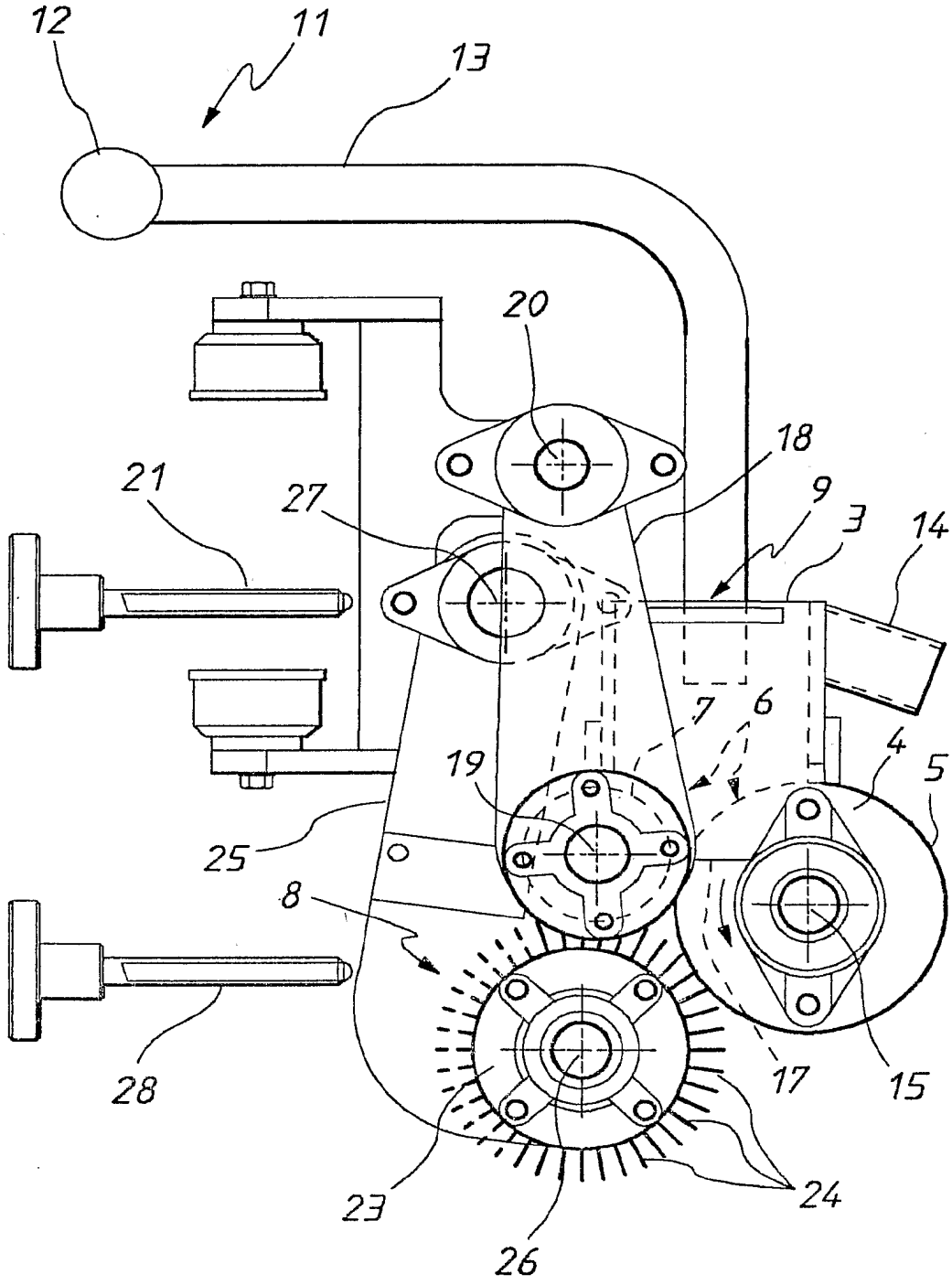

FIG.2

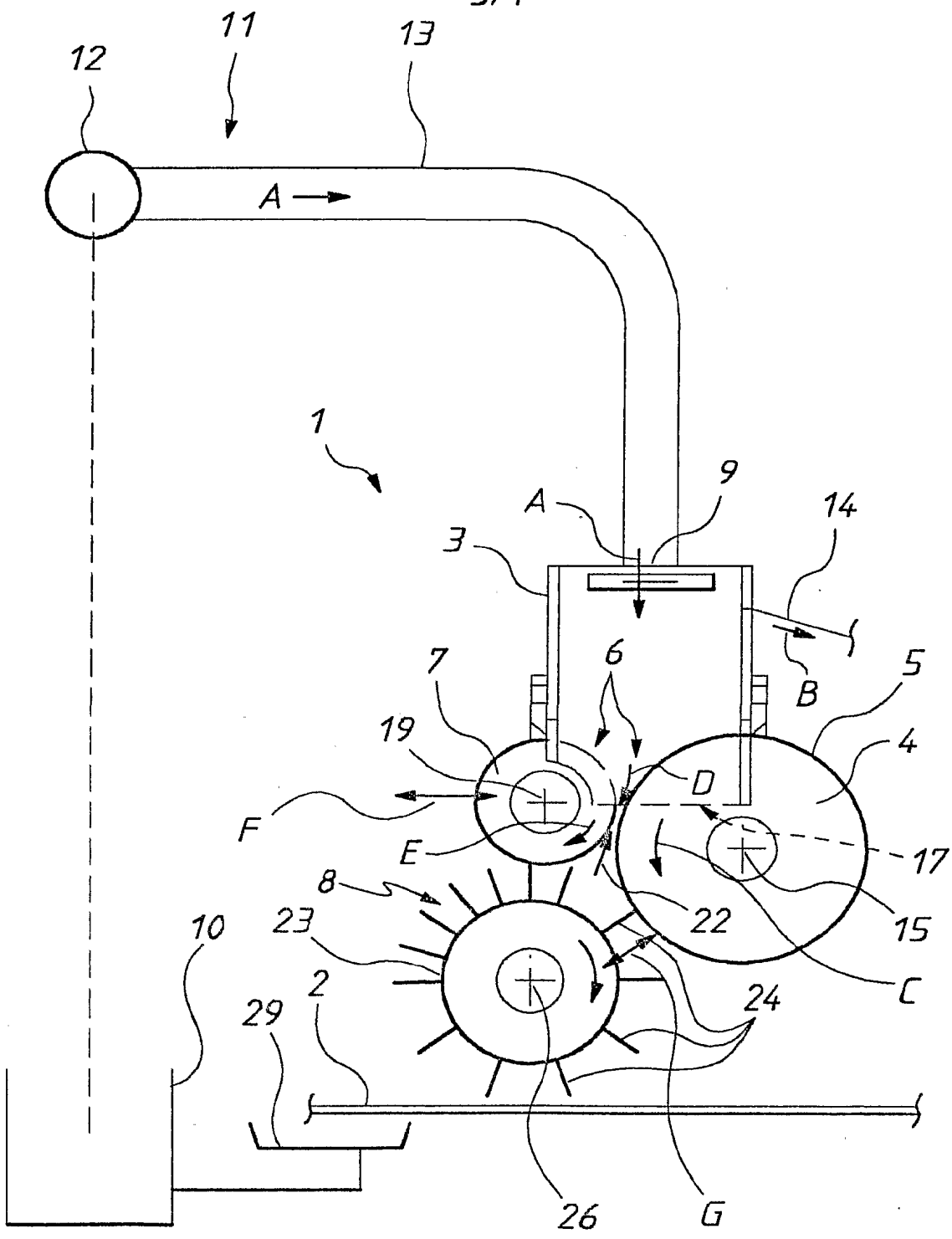

FIG.3

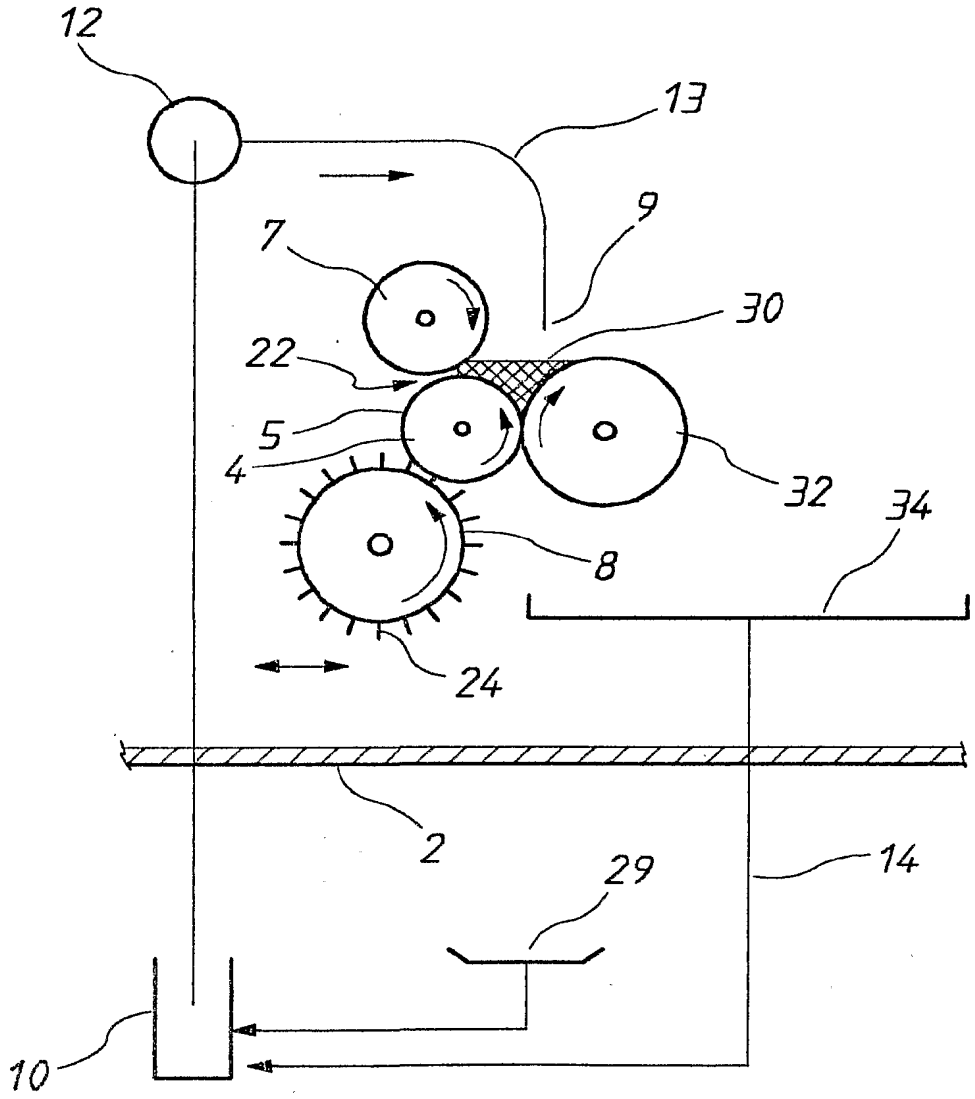

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU02/00226

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B05C 9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

REFER TO THE ELECTRONIC DATABASE CONSULTED BELOW

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI IPC B05C 5/-, 9/-, 11/-, B05D 1/- & keywords: slurry, spatter and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 97-443025/41, Class P42, JP 09-201561 A (KUBOTA CORP) 5 August 1997 Abstract	1-25
X	Derwent Abstract Accession No. 85-213103/35, Class P42, P64 JP 60-135211 A (MATSUSHITA ELEC WORKS) 18 July 1985 Abstract	1-25
X	US 4204644 A (KOZUKA) 27 May 1980 Whole document	1-25

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 April 2002	
Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**JAGDISH WABLE** Telephone No : (02) 6283 2638

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU02/00226

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
JP	9201561	NONE					
JP	60135211	NONE					
US	4204644	AU	29642/77	BE	860799	DE	2751661
		DK	5131/77	GB	1555266	JP	53063419
		NL	7712642	SE	7712950		

END OF ANNEX